SIGNIFICANCE AND PROSPECTS OF CAMEL PASTORALISM IN KENYA

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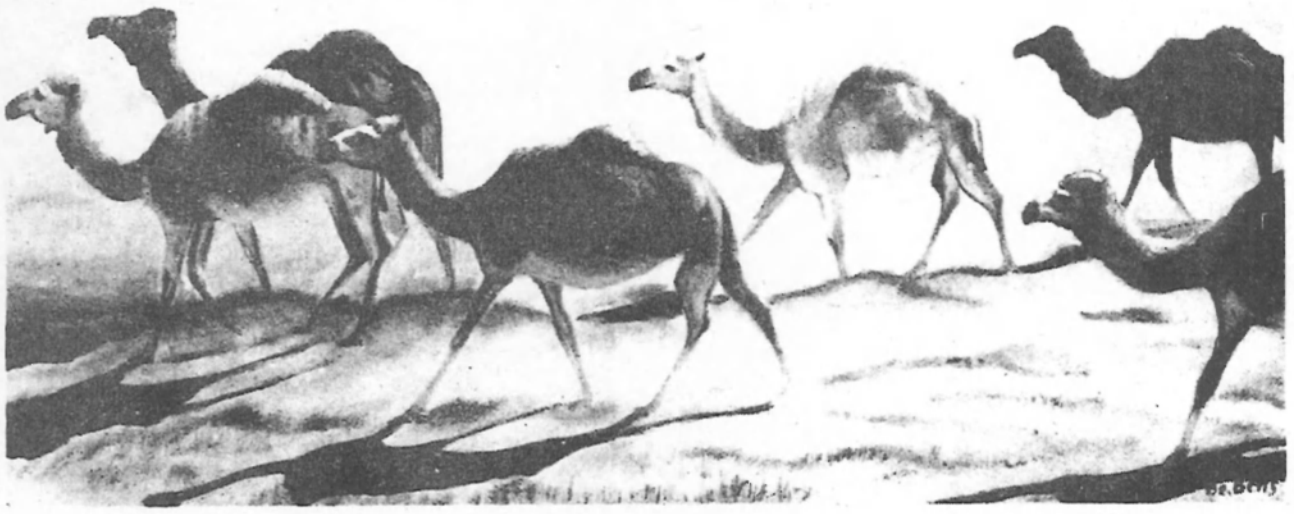

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INTRODUCTION

Background

For a number of years the Institute for Development Studies, University of Nairobi has devoted part of its research resources to the study of factors influencing livestock production and the development of pastoral societies within Kenya's semi-arid areas. But very little research has been directed so far to problems of development in the very arid areas where drought and famine have become very frequent making the life conditions of the noamdic pastoralists in those areas very parlous. It is with this concern in mind that this workshop was organised partly to familiarise researchers with on-going research and to identify possible research areas on pastoralism in the very arid areas of Kenya. This workshop was also the first of a series of some five planned workshops expected to involve some seven African countries in which camel pastoralism forms an important part of the survival strategy of nomadic pastoralists: namely Kenya, Somalia, Sudan, Mali, Mauritania, Upper Volta and Niger. Later, it is planned to bring together the summaries from the national seminars and to synthesise them into a single report on the state of camel pastoralism in Africa.

The workshop was financed by a grant of Kshs. 75,020 from the Swedish Agency for Research Cooperation with Developing Countries, made through the Scandinavian Institute of African Studies at Uppsala, Sweden. This grant was used to pay for the travel and accommodation of participants and the balance is to pay for the cost of production and distribution of the workshop report.

Objectives

The specific objectives of the workshop were (1) to pool together scientific information pertaining primarily to socio-economic aspects of subsistence oriented camel pastoralism; (2) to identify research gaps, and (3) to draw some tentative conclusions and suggestions about future production systems involving the camel.

Participants

An important aim of the workshop was to promote interdisciplinary research cooperation by bringing together participants representing different social science disciplines. It was recognised, however, that some very important studies of camel production systems had been carried out by animal production specialists, range ecologists and veterinary specialists. Thus it was necessary for more comprehensive and fruitful discussion, to include persons representing the relevant biological and veterinary sciences. Altogether there were eight participants representing the social sciences and six representing the biological and veterinary sciences. Although many of the participants were University based researchers, the majority of all participants had worked for UNESCO/IPAL, whose research and operational projects are concentrated in Marsabit district in northern Kenya. We also arranged with three camel owners from Garba Tula and Gafarsa in Isiolo district to attend. The slightly unusual approach to invite members of the communities under study to attend was a remarkable success. The camel owners made valuable contributions and indeed, local administrators and politicians praised the fact that the workshop was held within the camel area and that it provided for local participation. A complete list of participants is provided at the end of this report.

Papers Presented/Discussion

It was the general impression that the Kenyan administration and research community are gradually becoming more concerned about development in the country's arid north, and especially about the role of the camel. Certainly, the academic representation at the workshop would bear this out. It is also worth noting that a key administrator/planner Dr. L.J. Ayuko, head of the Range Management Division, showed a very keen interest in a paper presented in his absence, in the role of the camel and camel-herding in Kenya's arid areas.

A major observation emerging from the discussions is the fact that knowledge about camel pastoralism is fragmented and that one prime focus of the planned series of workshops would be the establishment of an inventory of existing knowledge. From this, it may be possible to identify

research gaps. The Marsabit workshop achieved a measure of success in realising this objective. There is, however, the danger of jumping to conclusions with regard to policy implications, before a thorough inventory has been carried out.

This is not the occasion to evaluate any research gaps. However, a few general remarks could be made: (1) the contributions form a mixture of studies based on primary and secondary sources; (2) the quality of many papers is high; (3) the geographical focus of studies based on primary data without exception refer to the western part of northern Kenya (Rendille, Gabbra and Turkana); (4) the presence of an international organization, UNESCO/IPAL in the country has been of decisive importance for many researchers' interest in the camel; (5) in spite of the production and marketing bias in the selection of papers there was also a keen interest in social and cultural aspects which was shown during the discussions.

SIGNIFICANCE AND PROSPECTS OF CAMEL PASTORALISM

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The problem

The one-humped camel is a domestic animal much neglected in connection with development issues. Nevertheless, it is among the more significant animals, utilized for subsistence production of milk and meat, as a pack animal for long and short distance transport, as a draught animal in farming, as a working animal and "meat store", and it is traded on a limited but significant market. It is a truly multi-purpose animal, the use of which varies greatly with ecological and cultural contexts. It has unique biological qualities in energy conversion rates, in its capacity to browse (and graze) in areas where no other animal can reach, and in its capability, when well-fed, to endure high temperatures. It is extremely well adapted to arid environments and causes limited degradation; little trampling with its big soft feet and selective browsing under constant move. Aspects such as reproduction, production and browsing behaviour have recently become subject to systematic scientific observation.

The picture is much more fragmented when we look at what the rearing of the camels entails in terms of the organization of human time and labour, and the ordering of social relations. Before a good understanding of camel production systems in such a sense can be reached, much data gathering and analysis remains. In order to create an inventory of the present state of knowledge in some countries hosting large camel populations, a co-operative effort has been launched between the Scandinavian Institute of African Studies, Uppsala, the University of Stockholm and national research institutions in the countries concerned.[1] Within the project, a series of workshops are carried out, each one held in a camel producing area with participation both from academicians and from the camel herding communities. As a follow-up to the series of workshops

we shall organize an international seminar to draw upon proceedings from the various national workshops and the knowledge found in international organizations and government institutions. This introductory paper indicates the context, the distribution of important camel production systems in outline, and some problems and features unique to camel pastoralism. The prime focus is not on the camel as an animal but, rather, on the conditions for making a living that people experience when they rely on camel herding. It is for this reason that we have sought the expert knowledge of camel-owning Elders. Even though they represent a particular segment within the camel herding communities, their knowledge on technical constraints on camel herding forms a major contribution.

The distribution of camel pastoralism

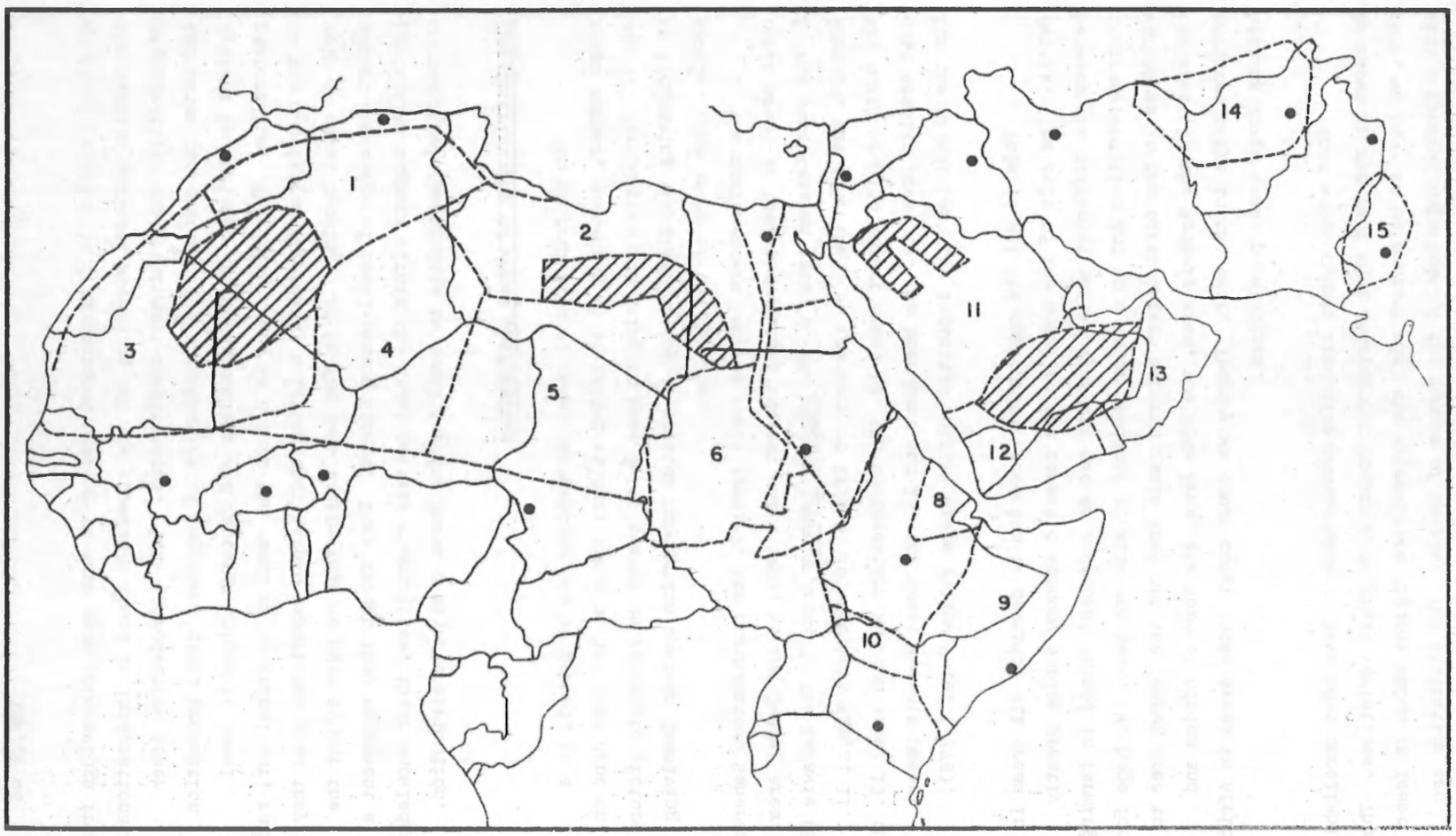
The distribution of camel pastoralism can be mapped, in a rough manner, according to so-called culture areas as has been done on Map 1. Our purpose for doing so here is to convey an aggregate picture by indicating the distribution of various production systems involving camels. The areas in the map are:

1. the northwestern Saharan oasis area; 2. the northeastern Saharan oasis area; 3. the southwestern Saharan oasis area; 4. the Twareg area; 5. the east Saharan area; 6. the baggara-jammala area; 7. The Bedawie (Beja) area; 8. the Afar area; 9. the Horn of Africa; 10. northern Kenya; 11. the north Arabian desert area; 12. the southwestern Arabian area; 13. the east Arabian area; 14. the Near East and 15. the Great Western Desert. For the Middle East the indicated culture areas follow Patai (1978).

This is not the appropriate occasion to describe all areas in detail. The role of the camel in the domestic economy varies greatly between the different areas, from its use as a draught animal in farming to transportation and to a major producer of milk and meat. We hope for workshops in the northwestern Saharan oasis area and the Twareg area to the west; in the Bedawie area, the Afar area, the Horn of Africa and northern Kenya to the east. Thereby we would cover those areas in Africa hosting large camel populations.

Most stock counts including camels seem to have been unreliable as shown by the fact that independent counts show great variations. Therefore, we have to be content with the approximate figures which at least hint a general magnitude of the number of camels. The statistics are

Map 1: THE PRIME DISTRIBUTION OF CAMEL'S (DROMEDARIES) ACCORDING TO CULTURE AREAS



organized on national rather than culture area basis (the difference is sometimes great, see Map 1). This fact aggravates the inherent difficulties of stock counts since the camel is a migratory animal with little respect for political boundaries.

The greatest number of camels are to be found in Somalia, Sudan, India and Ethiopia. Each of these countries hosts between one million and five million camels. Then follow Pakistan, Mauritania, Arabia, with half-a-million or more. Niger, Chad, Kenya, Iraq and Afghanistan host roughly 0.3 million camels each, while Morocco, Djibouti, Algeria, Tunisia and Mali have around 200,000 camels. Libya, Egypt, Iran and the former Spanish Sahara each contain 100,000. Camels are also to be found in Yemen, South Yemen, Eastern Turkey, northern Senegal and Nigeria, Oman, Israel, Syria, Jordan and Australia (Source; FAO, 1976).

Some key issues in camel pastoralism

The prime purpose of this paper is to give an overview of some key issues for production systems where the breeding and ownership of camels play a significant role. We also wish to indicate some strengths and weaknesses of such systems. The emphasis is entirely on camel pastoralism in Africa and Arabia. The two-humped camel is omitted altogether in the present discussion. The word "camel" in the following accordingly refers to the dromedary. Furthermore, we shall deal with the use of camels as draught and transport animals only in passing and indirectly as creating an outlet for camels from "family herds" kept by pastoralists. In the present context we feel that we should limit the discussion to those circumstances where the camel has a significant economic role, whether for food production or for marketing. Thus, we do not here deal with farming and transport systems.

A number of efforts have been made towards more generalized studies of cattle pastoralism as a social and economic system. To our knowledge, only a few trials from the analogous field of camel pastoralism can be found. One of them is Rubel (1969) who has tried to create a "generative model" for residential and kinship patterns, comparing a number of pastoral societies with varying emphasis on camels or small stock.. Her hypothesis is that small stock pastoralism necessitates a wider range of pasture and water than camel pastoralism. Small stock herders may have ideals of partrilineal co-operation, but be forced to

compromise these ideals in the practice of daily co-operation. The social organization of small stock herders must allow the individual herder to maintain a widespread network of alliances also outside his patrikin, ensuring access to such resources. Camel herding societies, because of the hardiness of the camel, can have a closer correlation between ideals and practice, so that the patrilineal ideology also becomes reflected in the organization of herding and everyday life. Rubel has been criticized (cf. Pastner 1971) for using untrustworthy data and for relying too heavily on simplistic assumptions on the hardiness of camels. One of her critics, I.M. Lewis (1975: 430, 1977) however, notes the correlation between cultural differences and variations in "species emphasis" among neighbouring pastoral peoples in northern Kenya, and suggests that different combinations of livestock could indeed provide a "generative model" for predicting forms of social organization. He does not venture out to do this himself.

In the following sections we shall try to point out some of the peculiar characteristics of camels as domestic animals. The focus is on such characteristics, that are likely to have a direct bearing on human time and labour organization and on economic relations between people.

The question however remains, whether these traits in the camel are so important and have such a pervasive and regular impact on social organization that we are justified to talk about "camel pastoralism" as an analytical category. There is certainly no one-to-one correlation between on one side ecology and technology and on the other social organization; nevertheless, it is worthwhile to try to identify what the peculiar aspects of a society's resource-base are.

Reproduction of family herds and society

Perhaps the first trait of camel keeping that we have to consider is that it by itself is fundamentally a high-risk undertaking due to the very slow reproduction rate of camels (see Sweet 1965: 1139, Stauffer qu. by Bulliet 1975: 265). Only when she is about six years old does the camel dam start to bear calves, and then normally only one calf every second year. This can be contrasted with the cow, which gives its first calf when she is about three or four years old and then another one every following year. If a camel-owner is struck by misfortune and left only with a minimal number of camels or none at all, the building-up of a viable family herd is a very slow process (Dahl and Hjort 1976:

260 f.). Breeding animals are expensive to buy, since those who have such animals in many cases are reluctant to part with them.

Losses of camels, then, are in many cases final and just about as definite as when a farmer or peasant becomes landless. One dramatic example is the fate of the Sakuye Borana in northern Kenya who lost virtually all their camels in a war in the 1960s. Practically all the Sakuye were pushed out of their traditional livelihood, being unable to provide proper care for the remaining animals and incapable of expanding their holdings fast enough to re-enter viable pastoralism. They were forced to leave their levelin order to seek other incomes and thereby lost effective control over their pastures, which are now used by other camel herders. In 1978 it was practically impossible even for rich Sakuye to purchase breading animals in the market (Dahl 1979: 52).

The hazards of camel reproduction have also been used as an explanatory variable by authors who have sought to understand the institutionalization of raiding (notably Sweet, loc.cit. for the Arabian camel-owning societies). By gaining animals in a raid, the herdowner can "make up for" several unproductive years in the development of his camels herd.

Another countermeasure against the high risks found in many camel-owning societies in Africa and Arabia is to have systems of property-holding, which redistribute the risks between herdowners. All animals of a particular patrilineal kinship group are in some senses regard as common property and marked with one single brand. Still, each individual herd-owner can dispose of his stock as he pleases as long as he fulfills his duties to take part in lineage redistributions of stock to the misfortune-stricken. Such redistribution may be organized by a council consisting of all mature herdowners in the lineage, or by especially appointed elders or tribal chiefs (Sweet 1965: 1137, Dahl 1979:172 ff.). Among the Sakuye, the lineage members were responsible for helping each other to retrieve lost livestock and to make a collection of a nucleus herd for any member who had lost his herd through misfortune. The condition was, however, that the recipient was not to have spent capital (female breeding stock) carelessly - for example by selling it.

All principles for redistribution naturally require a sufficient amount of animals under collective control. When the majority of camels belonging to the Sakuye people had been lost, counter-measures such as lineage redistribution were, of course, ineffective.

Lineage redistribution or other forms for collective redistribution may be supplemented with systems of individual loans of camels, so that the herd which is managed by one household belongs to a large variety of owners. Such a system of whole chains of loans has been described by Spencer for the Sakuye's neighbours, the Rendille (Spencer 1973:37).

Some follow-up issues for the study of camel pastoralism are: The camel family herd grows slowly due to biological and ecological conditions; Up to a point it is resistant against drought; In terms of the subsistence oriented economy, camels can be treated as a fairly constant resource. Internal systems for the redistribution of camels provide different "solutions" to a given "problem", that is how to cope with the constant risks that threaten the production capacity and the reproduction of family herds (and, hence, of society). Due to the high risks associated with herd regeneration the camel husbander must show utmost respect to capital expenditure. The cultural system often emphasizes this by social pressures against uncontrolled sales. In economic terms the return on the capital is low. The living standards of a camel owner, rich if he were to sell his animals, might be quite poor. Most of the immediate gains might have to be spent on reinvesting in the camel herd.

Management and labour

It is not only the pattern of herd reproduction that is significantly different for camels and cattle. Camels are able to move quicker and therefore reach far-away pastures. Such movements are normal for the purpose of achieving a necessary variation in diet. In comparison with cattle, camels demand more frequent and correctly spaced "salt cures" at salt licks or on pasture on salty soils, unless there is access to water with the appropriate mineral content. Mobility is also more vital for the health of camels than for cattle. Camel calves in particular are vulnerable to inappropriate nutritional qualities of the milk, that may result if the herd are kept stationary. Also, they easily fall victim to diseases, such as those transmitted by ticks breeding in dung, if their corral is not constantly moved. As counter-measures the pastoral camp should not remain more than a week or ten days on the same spot, and camels should be kept apart from cattle.

The degree to which the main body of household members follow the camel herd varies in different camel oriented societies. When they do, much labour is spent on the frequent erection and dismantling of tents.

The dry season, generally, seems to be the most burdensome one. The watering is very heavy. The camels require great volumes and they often must be quickly watered to avoid congestion. In the dry season, the camels become more restless. They tend to move into areas where they usually do not go due to predators or tse-tse infection and the herds are difficult to keep together. Sometimes the herd must be split and parts of it taken far away.

During wet seasons, herding and watering is easier, but a number of special management tasks have to be undertaken in connection with reproduction. The birth itself requires the attention of experienced herdsmen, but also dams about to calve have a tendency to stray which causes much trouble to their owner. The fodder intake of the dams must be kept under close surveillance, as an appropriate browse increases the calf's chances of survival.

Camel mating, at approximately the same season as camel birth, also involves the herders in much work. The bulls become aggressive and therefore one bull is normally used to cover all females in a herd to be mated. The rutting period is short and the risk of early miscarriage rather high. The early signs of pregnance are clear after as short a period as ten days, and pregnant females must be kept separate.

The literature on seasonal fluctuations in labour demand for camel herding seems a little contradictory in that varying work pressure is ascribed to wet season activities. It seems, generally, that dry seasons require all efforts to be spent on herding and watering while wet seasons require a range of management and domestic activities, possibly less toilsome.

Watering is always burdensome, especially during dry season. It is heavy work to draw up to 90 litres of water per animal from a deep well. Watering at pans, which is easy with cattle requires greater attention with camels especially at places where livestock of other species are watered as well - the camels tend to get into the water and muddy it and defecate in it and animals of other species refuse to take it.

To what extent can camel pastoralism generally be said to be more toilsome and demanding than cattle pastoralism? Two examples, slightly differing, may be mentioned in order to provide some tentative answers, from southern Arabia and Kenya:

Among the Al-Murrah of Rub-al-Khali, the cool season means a period when a lot of time has to be spent in aiding the mating and calving of the camels and in tracing camels who break away from the herd (Cole 1985:38). But it is also a time of plenty milk, and easy access to water and pastures. Groups from different patrilineal groups meet and there is much inter-clan feasting. In contrast, during the hot season, the members of a particular patrilineal group tend to congregate around its oasis or permanent well. There is not much herding, for the camels do not stray away from the waterplace, vegetation being very restricted to narrow and isolated patches.

In northern Kenya, the rainy seasons similarly involve both a lot of work linked to camel reproduction, and congregation and enjoyment. Since resources are abundant, but also because of a narrowing down of the areas open to camels, herds and people are concentrated to areas with good drainage. Families who during the dry season tend to be parceled out into many small sub-units are in the rainy season able to stay together. As the dry season proceeds, the main camps have to lie closer to the permanent water sources, but the camel herds and their herdsmen roam widely in search of pasture. "Almost every able-bodied person, including children from the age of seven, is pressed into service..." (Torry 1978:186). Wet season routines sometimes demand a very intensive input of labour by a restricted number of people. Dry season routines on the other hand put a strain on the number of people available, for there is a proliferation of tasks.

There are also several categories of camels that have to be given special attention. Among the Sakuye, for example, it is said that herdowners try to mate all their mateable dams with the same stallion and then, as soon as possible, separate this group from contacts with other bulls until it could be seen, as early as ten days after conception, whether the dams are pregnant or not - lest other rutting stallions cause miscarriages or hurt the dams. The dams and their sire would be sent away, while the newborn calves and their mothers, who constitute another group demanding special attention, would be kept close to the camp. This latter group are put under a certain rule of ritual seclusion and can only be herded and milked by chaste young herdsboys. Among the Al-Murrah, Cole found that there was particular concern over a similar category of newborn camel calves and their mothers, which had to be given water every week (1975:36), and that these were kept separate from on one hand the very mobile milch camels and on the other hand the pregnant dams which were left unattended close to the camp.

Some follow-up issues: Management requirements for camel family herds mean a high level of labour input seasonally. It seems that dry seasons require all efforts to be spent on herding. However, the general labour demand in camel pastoralism is presently difficult to grasp. Possibly, variations could be great. We may think not only of different breeds but differences in pasture qualities demanding or allowing for migrational differences, the availability to water (dams or deep wells), and the climatic variation between one and two rainy season areas and how this may or may not affect mating.

Species diversification

One way of counteracting the high risks of camel pastoralism is to combine camel rearing with the rearing of sheep and/or goats. Small stock reproduce quickly, and can accordingly provide a springboard back into viable pastoralism in the case of misfortune. This also implies serious constraints on man-power. Generally speaking there is less competition between the different species over pasture than over human labour. For example Torry (1977) indicates for the Gabbra in northern Kenya that "the labour intensive nature of multi-species stock management denies able-bodied persons considerable freedom from productive work by periods", especially as compared with cattle pastoralists. The Gabbra normally keep different kinds of stock in their household property and most Gabbra households are dependent on "immigrant" labour at critical seasons. Gabbra households in a camp also try to pool labour resources to cater for the family herds through such periods (ibid. 14-17). The requirement that animals of different species must be kept in different areas, leads, among the Bedawie in northeastern Sudan, to a situation where small-stock shepherds and camel herders are clearly two separate social categories. A shepherd considers it out of the question to try to establish a herd of camels. It would be too costly to obtain a core of animals, and labour costs for such a small, in itself unviable, camel herd would be too high for many years until the herd has grown sufficiently for balanced food production. The camel herder, on the contrary, normally supplements his family herd with some small-stock more easily. He prefers to keep his camel capital untouched and prefers to slaughter sheep or goats instead when meat is needed. Labour demands for small stock can be met by young household members.

Balancing off the disadvantages of one animal species with the advantages of another means that the household or minimal herding unit must

be large so that it can give specialised care to each kind of animal. For example, camels should not be kept in cattle areas for health reasons and camels may demand purer water than other species.

Some follow-up issues: Species diversification seems to be an opportunity for large and already viable households to further improve their security through risk spreading. Judging from fairly scanty literature, it seems that conversion rates between small-stock and camels changes, when regular markets are established, so that a sheep or goat becomes less valuable relative to a camel. Is there in fact, a tendency towards increased social and economic stratification between the "haves" and the "have-nots"? Does this imply a shift of camel rearing from intensive practices with a multi-purpose food production from family herds towards more extensive practices with production geared towards marketing? If this is the case we shall witness a concentration of camel production in the hands of the relatively few well-off citizens controlling many camels.

Subsistence production

In spite of the fact that a good number of monographs exist on groups concerned with camel herding, detailed production data is scanty. The main food product obtained from a camel herd is milk. A camel is in many ways a more reliable source of milk than a cow. A Sakuye camel dam in northern Kenya can be expected to give about 4 kg daily as compared to 0.5-1.5 kg for a cow in the same area; in the peak of her lactation she can give even 12 kg. Knoess,(1976:43) found average daily milk yields of between 2 and 8.4 kg in Afar camels in Ethiopia. The best Bedawie camels can give 12-18 kg daily. The length of lactation may reach 18 months and a year is considered normal under traditional pastoral management. This means that in the best case, the owner of a number of camels can have secure access to milk throughout the year. However, normally a shortage occurs towards the end of dry seasons. This is especially the case in areas with only one rainy season, when a majority of the camels are at the end of their lactation just before the onset of the rains. The end of the dry season easily becomes a critical period of food shortage for the pastoralist if he has no access to grain or other products "external" to camel rearing. It is interesting to note, that the main area where pastoralists rely almost entirely on off-take from the family camel herds is in northern Kenya, which has an expected pattern of two rains per year. There, sections of the Rendille and the Gabbra live almost exclusively on the products of their camels and small stock. The same situation applied, historically,

to parts of Somalia.

If one or two consecutive rains fail, there is a delay in camel reproduction and hence lactation. Such a situation can become more serious than in cattle rearing or small stock pastoralism since the milk accounts for a major portion of food intake. There is also an acute conflict between the need of milk for human consumption and what is required for the calf's survival, between human subsistence and investment as it were. The camel owner may in the case of a prolonged drought go even one or two years without a new period of lactation, and even risk that all his camels go into lactation simultaneously. If they do, the herd will give one year of abundance at the cost of next year's milk supply.

Seasonal variations in camel milk production are great and much surplus milk is wasted during rainy seasons. Camel milk can be soured but milk products such as ghee or cheese cannot be obtained without new technology. This is due to the fact that the chemical composition of camel milk differs e.g. from that of cow's milk. In southwest Asia there is a practice of sun-drying camel milk. The product is used to cook a soup.

Access to milk goats and to sheep and bucks for slaughter ensures a more steady supply of food. Goats go in milk more quickly after the onset of rains. This is one of the reasons why camel rearing is frequently combined with the husbandry of small stock.

Subsistence pastoralists rarely slaughter camels for internal meat consumption. Only in the context of ritual occasions or large gatherings does such slaughter take place, or when the camel is old and weak. This practice is due to the value of she-camels for reproduction. To slaughter a camel is a major decision, but the gap after a slaughtered goat or sheep is quickly filled. The meat of small stock can also easily be consumed by the family without involving any larger group in communal sharing.

Camels are occasionally bled to provide for particular human demands of iron, salts and other nutrients. The use of camel blood as human food seems to be restricted to those nilotic peoples who have acquired camels (notably the Turkana), to camel-owning Boran groups and the most western Somali; it is not acceptable to orthodox Islam.

Apart from the production of milk, meat and blood, camels supply hides and, theoretically at least, wool. Knoess (1976:50) suggests that Afar pastoralists should be made to sell their camels wool, and notes that the use of camels' wool is unknown in Ethiopia. The same goes for the rest of the Horn of Africa. Hides are used by pastoralists for household utensils, whips and sandals and, in some cases, exported.

Some follow-up issues: Milk production figures, as well as detailed herd structure figures, are not very common in literature. It seems, however, that milk production is quite high. The nutritional qualities of camel milk are excellent and its content of Vitamin C unique. The great seasonal fluctuations invites effort to be spent on milk preservation and milk products. This could open up local markets. Also wool production seems to be an area for possible increased attention. The marketing of live animals is considered in the following section.

Marketing

As mentioned above, the only area in the world where camel pastoralism seems to be predominantly subsistence-oriented is northern Kenya. Even there, camel pastoralists rely to some part on neighbours practising hunting or alternate forms of pastoralism. There is practically no market outlet for camels in the area, a fact which reinforces the subsistence focus of camel production. Most camel pastoralists outside this region, depend more visibly on exchanging some form of goods or "services" with their neighbours in order to obtain supplementary foodstuff from them. Camel milk continues to be important food in such societies, but the diet is not exclusively built on it.

It is difficult to ascertain the extent to which camel pastoralists in Africa and Arabia have traditionally been oriented towards a meat market. Due to the long intervals between camel births, it is hard to perceive of any camel production as primarily meant to supply meat for the market. Bulliet (1975:265) mentions markets for camel meat in Libya and Morocco, and in the 1960s, when Asad made his study of the Kababish of Sudan, the latter were, despite serious legal restrictions engaged in export of camels to the Egyptian market (Asad 1970:33). The same trade is carried on today alongside increased Sudanese exports to Saudi Arabia.

In 1970, Ibrahim and Cole (1978:23) noted that hardly any camels were sold by the Al-Murrah Bedouin. The camel-meat in urban markets came

solely from aged animals. In 1978, however, a majority of those pastoralists whom they came into contact with had been involved in such sales. Hence a shift seems to have occured towards a higher degree of marketing camel meat.

In northern Kenya, prices have risen considerably both for male and female camels during the last decade, a fact which is usually explained by increased Saudi-Arabian demand. Swift (1979:451 f.) also reports a recent increase in the Somali camel export, not least to Saudi-Arabia. However, since then export figures have gone down. The relation between this decrease and the market demand is not clear. Cole (1975) states that although camel meat is no longer as popular as it once was, there is now a great demand for purebred milk and riding camels by the Saudi-Arabian elite and marketability is increasing. What then about the suggestion by Schmidt-Nielsen (quoted by Bulliet 1975:264) that "the camel offers a most obvious solution to increased meat production in arid zones with a low natural vegetation density that cannot easily be increased"? One can answer, that despite the camel's superior adaptation to arid climates, the risks are high, meat off-take fairly low and labour costs high. In the case of Somalia, a report from USAID indicates an annual off-take of 5% including both domestic meat consumption and export (USAID 1979: Annex 11:6).

Some follow-up issues: The marketing of live camels is a significant trade especially in those countries with a large population. Prices have soared and offtakes have been so high that many area herds decrease in size. Also female camels are traded although most countries have an export embargo on such animals. We may return to the questions raised above concerning stratification impacts. Maybe it is also possible to speak about camel ranching on cooperative basis as an alternative to an emerging system of middlemen.

Transportation

It is a well recognized fact that the caravan camel has had a great historical significance for North Africa, the Middle East and the Near East. It was accentuated recently by Bulliet (op. cit.) in a volume which presents an original discussion of how the domestication of the camel and the invention of the camel saddle 2,100 - 2,500 years ago brought a revolutionary change to transportation techniques and hence "transformed

the economic, political and social history of the near East" (ibid:87). Transportation became less costly by camel caravans than by wagons which had been used before, and militant camel nomads "offered" their protection and took over the trade.

Today, in the context of long-distance trade, the camel as a pack animal has been replaced by motorized transport. But its use as a work animal is still significant among many Arabian and Saharan people, who do not necessarily themselves breed camels. The use of camels for plowing is common in many farming communities, for example among Bedouin cultivators in North Africa and among farmers in Yemen. Access to good transport animals is also crucial to people who pursue other forms of pastoral nomadism than those built upon camel rearing. For example, in Isiolo District in Kenya, there used to be two groups of Boran pastoralists, one specialized in camel-rearing, and the other in cattle-rearing. Until the camel economy broke down in the 1960s (due to the secessionist war) the cattle-owning families used to have two or three camels each for transport purposes. This easened their movements between different camp-sites when pasture conditions necessitated such moves. Scarcity of transport animals has now slowed down their pastoral movements to an extent detrimental to the care of cattle and small stock. Their transport camels used to enable them to put up their camps at a distance from the rivers and wells, which was advantageous both from human and animal health reasons and for the preservation of pastures close to permanent waters. The camels could transport domestic water to the human household, or water and grass to animals which had to remain in the camp (young or sick animals) or even transport weak small stock or calves from one place to the other. Within the camel economy itself there was, of course, also quite a demand for transport camels, reducing the proportion that could be exported without problems.

Camels need close attention and constant movement if they are to reproduce well. The area where camels can reproduce is usually more restricted than that where they can be put into work, and hence one will find transport and work camels more scattered than camel dams. The literature on camel economies very frequently does not recognize this fact, and many sources state number of animals owned in terms of a sexually neutral category, which makes it difficult to judge the nature of the camel's economic role in the society concerned.

Some follow-up issues: The number of people who actually depend on carrier camels may be considerably larger than the number of people who are actually specializing in camel pastoralism. It may even be, that it is in relatively short-distance transport, for small pastoral producers and farmers, that the camel has its most important role rather than in the context of caravaneering. There appears to be a general opinion among writers on camels, that the demand for transport animals is decreasing, an opinion based on the observation of the changes in the structure of long-distance trade. Certainly more research is needed to answer the question of such trends, and to sort out if there are also changes in the demand for short-distance transport animals.

Predatory pastoralism

Having discussed the camels' capacity for subsistence and commercial production we should also consider a third historically important aspect, which follows from the extreme mobility of the camel, namely its political role. The areas where we find camel pastoralists today are areas in the periphery of central states; areas where scarce resources make it uneconomical to try and maintain strict political control over people who tend to evade such control; pastoralists can often react to political pressure by retreating into inaccessible regions. They are difficult to rule, but have also enjoyed military advantages through their animals' ability. This leads us to note that there is a specific pattern of predatory camel pastoralism (Bourgeot 1975:281) which is neither primarily subsistence-oriented nor using the camel as a means of direct production of marketable goods.

The Twareg (Tabashek) are a good example of this. In the traditional Twareg society, camel ownership tended to be restricted to a hereditary caste of noblemen , whose herds were tended by slaves. These slaves were of a separate ethnic origin (Negroid) like the sharecropping vassals using land owned by the noblemen. Commoner Twareg specialized in religious services, in goat rearing or oasis cultivation and paid tribute in kind to the camel owners in return for protection. Bernus (1975:243) describes how, under the colonial pax, this service offered by the camel-owning noblemen lost its meaning and had eroded, giving rise no longer to castes based on qualitative criteria of types of wealth but instead to more clearcut quantitative inequalities. The Twareg noblemen were typical of a system, where camel-owning sections of diverse ethnic groups all over the Saharan area were able to maintain control over restricted patches

of land of particular value - oases for cultivation, caravan centres, permanent well-fields, depressions with good grazing. Some of them, like the Daza of Borku (Johnson 1969:148-157) maintained outright ownership over oases or palm trees but did not themselves cultivate, leaving this to vassals or ex-slave groups, and returning only for the harvest. The Daza and their northern neighbours of Tibesti, the Teda, used to collect dates in early winter, and then use their nomadic camps as bases for caravans to more sedentary people in order to exchange these goods for grain.

Systems of vassals and patrons are also found among the bedouins of Libya and the Arabian desert area. In these areas, one can find dominant groups of "noble" camel-owning Arabs who control land and are-ascribed an elite status through reference to their places in tribal genealogies. In north Arabia, a system of ranked lineages is combined with a system of political control over vassal groups of small-stock shepherds, cultivators and hunters. This is exercised through control over pastures and wells along the trekking routes and over some oases (Sweet op. cit.:1134) from which the noblemen extract dates and wheat yearly - either by force or as shares from their proprietary holdings (ibid:1138).

Some follow-up issues: What is the future of such systems? Most likely they will erode under the influence of modern commerce and the growth of a centralized state structure, which are more sedentary; living is in a more closer contact with the state representatives. Political influence through "protection" decreases in influence with the growth of the state - and predatory camel owners are possibly subjected to a change such as in Saudi-Arabia where now the politically most influential herdowners are those with the largest sheep flocks, rather than those owning camels. However, given the high value of the camel (in any economic perspective) the high incidence of stock theft experienced today can be anticipated to remain high.

Camel pastoralism and current research

In the last section we have outlined a range of aspects relating to camel rearing: reproduction of family herds and society, management and labour, species diversification, subsistence production, marketing, transport and finally warfare and raiding. There are so many unique qualities,

for good and for bad , pertaining to keeping the camel as a domestic animal for us to utilize the term camel pastoralism.

The distribution of the camel (dromedary) is limited to drylands in Africa and Asia. It is only logical that interest in the camel by the international research community should grow when drylands have been given great attention. The camel and camel husbandry are obviously fields which are under-researched both from social, economic and veterinarian perspectives. Furthermore the sector is obviously undergoing a great change; a steady flow of young people to the labour markets has rendered camel management less efficient due to an acute labour shortage in many countries. A later question, having analyzed current production systems will undoubtedly be: What new forms of camel management we are likely to see in the future?

During recent years some researchers and a few institutions have pointed out this fact and begun to establish a better state of knowledge. In 1979 the International Foundation for Science (IFS) arranged a conference jointly with the Veterinary Faculty of Khartoum University, Sudan. The conference proceedings, still under revision to be published as a book, are made up of a number of more or less specialized articles. Veterinary medicine and animal husbandry is highly represented in the proceedings, and it can be observed that economic issues, if touched upon at all, solely relate to commercial projects. We hold that the overwhelming economic importance of the camel for the herding communities is with the clearly under-researched subsistence sector. Improved knowledge about its conditions are vital if one is to introduce a supplementary, commercial activity sector with any success.

An ILCA, the International Livestock Centre for Africa, report to the Khartoum conference (Ortiz and Mukasa-Mugerwa, 1979) was later revised into a comprehensive summary of camel husbandry (Mukasa-Mugerwa 1981). The report is wide in subject approaches and summarizes fairly well what is known today in the research community. However, it does not problematize the issues we are interested in here, to seek societal constraints and opportunities grown out of camel herding.

Some other research efforts should be mentioned. Bulliet (1975) has written a fascinating account of the economic history of the camel called The Camel and the Wheel. Gauthier-Pilters and Diggis (1981) have compiled their research results under a fairly general title, The Camel: Its Evolution, Behavior and Relationship to Man. This volume and some

high-quality articles by Gauthier-Pilters are among the best research available. Trevor Wilson is expected to publish one bibliography on the camel and one book on husbandry aspects. We have not yet had access to the latter but we anticipate that it deals with productive and reproductive capacities of the camel. Richard (1980) has recently compiled a comprehensive bibliography with an emphasis on veterinary medicine. An excellent, though not quite comprehensive, bibliography by Farid (1981) has been published by the Arab Centre for the Studies of Arid Zones and Dry Lands (ADSAD). The level of knowledge on camel milk is given by Yagil (1982).

So far ongoing and recent camel research is of fairly wide scope. A number of more localized studies are underway or have been finished recently. Substantial veterinary research can be found at the University of Khartoum (Sudan), the Somali National University, the University of Nairobi (Kenya) and King Feisal University (Saudi Arabia). ILCA is at least indirectly involved in some camel research (southern Ethiopia, Afar, Mali). UNESCO is running a large-scale IPAL programme in northern Kenya. SAREC and the Somali Academy of Sciences an Arts support an interdisciplinary research project.on the camel in Somalia.

The relative lack of interest in camel research in the academical community is in itself an interesting phenomenon (Why has it not been "in"? What has made it "in" recently?). For many planners the camel symbolizes "tradition" and "conservatism". There is no room for the camel in a "modernization" mode of thinking, except possibly as a contributor to export revenues. Development projects rather favour other livestock at the expense of camels if not explicitly so by their emphasis on sedentarization, at odds with the necessary mobility of the camel. This kind of situation and attitudes to problems relating to arid lands has, in turn, a negative impact on research, both in terms of a general dis-interest in camel research and in terms of a lessened quality of research in many universities of developing countries. The few researchers and institutions who presently try to make way for advanced camel research deserve all support. Camel research is presently becoming a fashion in expatriate research communities which could result in negative communication gaps if no national researchers pay an interest as well. As a balance, we would like to propose increased regional cooperation between countries covering whole culture areas, so that the current problems experienced by herders can be identified before plans for development are formulated.

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Notes

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Camel Pastoralism in Kenya: A Geographical Analysis of Distribution and Growth Factors

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INTRODUCTION

According to Mason and Maule (1960), all camels in Eastern Africa belong to three broad categories often referred to as the Sudanese camel, the Eritrean camel, and the Somali camel. This geographical approach to the identification of camels emphasizes the original habitat of the camel. Out of these three broad categories, eleven types of camels could be identified. In Kenya, the Species Camelus dromedarius is more common, and the dominant type is the Bendir of Somali.

Another method of identification utilizes the names of the major tribes which are camel pastoralists. Hence, in Kenya, three types of camels are found, commonly designated as the Somali camel, the Rendille or (Gabbra) camel, and the Turkana camel,

It is also feasible to identify camels on the basis of their transportation services. This latter approach yields only two types of camels often referred to as the baggage camel and the riding camel.

Fazil (1977) described the riding camels as light and finely built with most qualities which make them more agile. On the other hand, the baggage camels vary in size and conformation. Some of these camels are large and clumsy. Their physique is generally broad, thus making them best suited for carrying loads. What are then the geographical factors determining their distribution and density?

Regional Differences in Distribution and Density

Among all livestock, the camel has the most restricted distribution not only in Kenya but throughout the entire Eastern Africa. According to the estimate of 1964 given by MacGillivray (1967), Kenya probably had 1.3 million camels compared with only 1000 in north-eastern Uganda and, none in Tanzania. Even though, in Kenya, camels were still confined to only three provinces namely North-Eastern Province with about 61.3% of the total number, Eastern Province with 31.4% and the Rift-Valley Province with approximately 4.7% of the total camels.

A recent animal census carried out by KREMU in 1977-1978 revealed one significant geographical fact about the spatial pattern of camel distribution. This census survey portrayed the distribution of camels as confined mostly north of the equator. Kenya is, therefore, regarded as the southern limit in camel distribution in Africa (Pratt and Gwynne, 1978). Further reference according to figure 1, shows the following features concerning regional differentials in camel distribution and density. A cluster of very high density which is constituted by 10-20 camels per km^2 occurs in a restricted belt of 140 square kilometres. This cluster of very high density occurs in an elongated belt which extends from south-west to north-east, viz from the eastern parts of the Chalbi desert and across the northern section of the Marsabit National Park. Note that this band of very high density encompasses some of the extremely arid areas of Marsabit district.

The next band of moderate density with 5-9 camels per km^2 occurs in two isolated regions. The largest region of moderate density occupy the extreme north-eastern horn of Kenya, which covers nearly the whole of Mandera district and a restricted portion of the northern parts of Wajir district. The other small isolated island of moderate density (5-9 camels/km^2) is within the Marsabit district. This area which extends from the south-eastern parts of North Horr covers an area of approximately 80 sq. kilometres between Huri Hills and the northern parts of Chalbi desert. This section of Marsabit also has some very arid conditions.

The third density pattern has 1-4 camels per km^2. This low density pattern also occur in three distinct discontinuous regions. The largest region encompasses the whole of Isiolo district, the northern parts of Garissa district (Ewaso Ngiro), the northern parts of Tana River

district (Hola), the whole of Western Wajir district (Khorof, Harrar, Bokhol, Wajir location and Dif,)and the eastern parts of Meru district. It should be noted that, this eastern zone of low density is separated from the moderate density zone in Mandera district by a region where no surveys were carried out by KREMU due to security problems. A similar region is found on the eastern parts of Wajir district along its border with the Republic of Somalia. Another enclave of low density (1-4 camels/km^2) is found in Samburu district, especially, within the EI Barta plains. Further reference to figure 1, portrays the whole of Turkana district as a low density region, while the third low density region covers an area of 40 square kilometres around the northern parts of Lake Baringo along the Suguta Valley.

The regions of noted low density are sorrounded by a sea of extremely low density in which the population of camels is about 1 per km^2. These very low density areas extend from the northern parts of Marsabit, except for a wide area north-east of Lake Turkana (Ileret region) where security problems prevented KREMU census surveys. This belt of very low density, then, extends southwards through Samburu district into Laikipia district where the margin of the high potential agricultural land limits its extension. Its western margin is also bounded by the Kerio Valley as shown by figure 1.

Regional Variations of Camels Growth Rate

According to MacGillivray (1967), the estimated number of camels in Kenya by 1964 was approximately 1,265,000. However, a more recent estimate in 1978 gave the estimate as approximately 640,600. (KREMU, 1981). It should be noted that KREMU admitted that some parts of the dry lands of Kenya were not surveyed because of poor security. Furthermore, it is realised that KREMU field methodology which involved both aerial surveys and sampled ground surveys might not have been the same methodology employed by MacGillivray (1967) in his estimate of camel population throughout East Africa. In other words, differences in field methodology could yield differences in the degree of accuracy thus rendering comparision of data collected with different methodology naive. If MacGillivray's figures are correct, then there must be endogenous and exogenous factors explaining the apparent decline in population numbers and density.

Nevertheless, could we accept the proposition that the population of camels in Kenya has been declining? There is evidence, however remote, to support the proposition. First, there is historical evidence that the entire dry lands of Kenya have experienced some of the worst droughts during the past two decades. The droughts of 1960/61 and 1979/80 were probably the worst, for even camels which are known to be drought resistant, died in large numbers (Odegi-Awuondo, 1983). It is only unfortunate that no records are available to verify the actual number involved. In addition, it is hy pothesized that the problem of insecurity in these dry lands as reinforced by ngoroko* and shifta* banditry should have adversely affected the population size of livestock in these regions. The situation is worsened by such acts of banditry which involve mass transfer of livestock across international boundaries, i.e. into Uganda, Sudan, Ethiopia, and Somalia. Lastly, the recent attempt to commercialize camel trade (Pratt and Gwynne, 1978) might have also affected the population of camels though lack of interest in it by camel pastoralists probably neutralised its effect.

A brief summary of regional percentage changes in camel population between 1972 and 1978 is given in Table 1. It should be stressed that the listed districts experienced extremely high percentage change which ranged between 10.% for Samburu district and 443.1% for Garissa district. Note that lack of data for other important districts such as Isiolo, and Marsabit makes it difficult to generalize on growth trend.

Table 1. % Change in camel population for selected districts in 1972 and 1978.

District	Census of 1972	Census of 1978	% change 1972-78
Turkana	26,986	112,000	315.0
Garissa	9,600	52,140	443.1
Wajir	76,000	127,700	68.0
Mandera	90,400	114,800	27.0
Samburu	12,000	13,200	10.0

Source: KREMU Technical Report Series no. 21, March 1981.

NB. * Ngoroko is a local term for cattle rustlers. Shifta also refers to Somali cattle rustlers, although recently it has acquired a meaning which includes political dissidents of N. Eastern Kenya.

A study carried out by Gudrun Dahl and Anders Hjort (1976) suggests that camels in general commence reproduction at the age of 6-7 years and have a reproductive lifespan ranging between 6 and 21 years. Though other studies suggest that the reproductive period starts early at the age of 4 years, what is probably more important is the actual length of the reproductive period which is about 15-16 years. Furthermore, the cited study generalizes that each female camel produces about 8 calves in her lifetime and that about 50% of the calves are females. In addition, Gudrun and Anders suggest that the average maximum annual growth rate in a camel herd is about 8% and this rate is fairly constant thus yielding a stable growth trend ceteris paribus. However, growth rates of camels in Kenya are believed to be relatively low probably due to high mortality rates (Gudrun Dahl and Anders Hjort, 1976).

It should, however, be stressed that camel reproductive behaviour which enables reproduction only every two years (Fazil, 1977; Pratt and Gwynne, 1978) is a serious physiological constraint to a rapid population growth rate. The situation is aggrevated by the high mortality rate of the calves which are less than 1-year old. According to Fazil (1977) about 30-50% of calves which are less than 1-year old die. Even the estimate given by Pratt and Gwynne (1978) is higher for they stated that between 50-70% of camel calves die before reaching their first birthday. Under such mortality conditions, growth rate is bound to be extremely low. Conclusively, the already implied (observed) high growth rates of camel population of the listed districts must be attributed to massive spatial re-allocation caused by migration of camel pastoralists. It is this geographic phenomenon which make sense of the change in the total population of camels in Kenya from 602,900) in 1977 to 640,600 in 1978 (KREMU, 1981). In other words, the observed growth rate of 6.3% in one year cannot be attributed solely to increased fertility level of the camel population in view of the observed mortality rates.

It should also be realized that, despite the high mortality rate experienced during infancy (note that camels have less resistance to many diseases compared to other livestock), the survival rate of camels reaching their 3rd birthday, i.e. those which are three years old, is extremely high when compared to that of other domestic stock. The main factor is that camels generally are more resistant to drought than other domestic stock.

Ecological Characteristics of Camel Habitats

All geographical units which can support camels in Kenya have three distinct ecological zones. Reference to Table 2 shows that these zones are designated as eco-zone IV, eco-zone V, and eco-zone VI. It is, however, important to note that these eco-zones have been derived on the basis of a combination of climatic and vegetation characteristics.

It is also evident from Table 2 that with the exception of only two districts namely Mandera and Marsabit, the eco-zone V is the most dominant spatially. Yet, the two districts with a relatively large population size of camels namely Mandera (114,000) and Marsabit (30,000)*, had over 98% and 74% of their land area under eco-zone VI as depicted by Table 2 respectively. It is, therefore apparent that the other districts which are dominated by eco-zone V have very low to low density patterns. This situation suggests that other domestic stock have greater value under eco-zone V if compared to the value accorded camels. See Table 1 in the Appendix.

However, the two eco-zones V and VI should constitute the natural habitats for camels in Kenya.

Table 2. Ecoclimatic Zone IV - VI

District	Percent of district land in each eco-zone		
	Eco- zone IV	Eco-Zone V	Eco-Zone VI
Turkana	9	54	35
Marsabit	2	24	74
Mandera	-	2	98
Wajir	-	81	18
Garissa	12	82	6
Isiolo	6	46	54
Tana River	4	93	-
Samburu	12	69	7
Baringo	19	61	1
Kitui	5	92	-

Source: R.B. Ogendo in The Kenyan Geographer, Vol. 5, No. 1-2, p. 125.

*The figures given for Marsabit relate only to the number in the IPAL area. Actual data for the whole district has not been obtained.

According to Griffiths (1962) these two eco-zones have mean annual rainfall of less than 500 mm. Rainfall is usually distributed in two seasons which occur in April and November. Furthermore, these regions have hot to very hot climatic conditions with mean annual maximum and minimum temperature recordings of 34°C and 23°C respectively. In fact, the mean maximum for the hottest month seldomly exceed 37°C and temperatures reaching 40°C are extremely rare. In addition, a diurnal variation of 10°C is typical. These temperature conditions normally reinforce high evaporation rates which exceed 2500 mm in these eco-zones. Conclusively, water is a major problem affecting range management of these dry lands. The moisture index for eco-zone V vary between - 42 to - 51, while that of eco-zone VI vary between -51 to -57 (Pratt and Gwynne, 1978). With such serious water deficiency plants growth is also limited to various species of seasonal grasses, dwarf shrubs, bushes, and ever-green and semi-deciduos plant.

It is for the above factors that, the camel is found to be better adapted for arid and semi-arid conditions which necessitate endurance of frequent and long droughts, and the need for constant migrations. A camel can survive for months without water during rains when plenty of good forage is available. Even during drought a camel can survive without water for several weeks if fed on dry food and not subjected to any work (Fazil, 1977). Furthermore, Pratt and Gwynne, (1978) noted that a camel can withstand an exceptional degree of dehydration of the body up to 25% and then recover the loss of body water in a matter of just a few minutes. According to Schmidt - Nielsen, et al (1956), the noted loss of body water is at the expense of water in the body tissue rather than the blood plasma which diminishes very little. Camels are therefore known to drink large quantities of water, 30-100 litres, at a go depending on the amount of water loss from the body. It should be stressed that, this unique body physiological adap tability enables the camel to tolerate a wide range of temperature variations. With the noted diurnal temperature changes of up to 10°C in eco-zone V and eco-zone VI the noted body mechanism of camels is an advantage which other domestic stock do not posses.

The camel wool coat and its relatively large sweat glands offer further protection against dehydration, because camels do not start sweating until body temperature exceed 40°C (Fazil, 1977).

Another advantage for the dry lands management is that camels unlike cattle and sheep are browsers. They are also known to accept a wide range of forage plants compared to cattle. This is an important ecological specificity because as protrayed by figure 2, the dominant vegetation communities in eco-zone V and eco-Zone VI are Wooded and Bush - grassland on the plains and plateaux, as well as, woodland on river valleys and mountain slopes and, Grassland and dwarf shrub-Grassland in dry river valleys. Camels are, therefore, known not to compete with other stock for forage. It however, has preference for certain vegetation species of acacia, trees, and shrubs of water courses such as Boscia and Salvadora species. In Samburu district camels browse exclusively on Duosperma (Disperma) and other dwarf shrubs such as salt-bushes which are avoided by sheep and cattle. The other plants species preferred by camels are Sueda monoica and Salvadora persica, thorny species, and some aromatic species. Note that camels can utilize trees up to 3.5 metres above the ground (Pratt and Gwynne, 1978). It should be stressed that camels reliance on deep rooted trees and large evergreen bushes which are the only reliable source of forage during prolonged drought gives them better prospects for survival when other vegetation species are dead.

Another significant range management factor is that camels make use of natural salt-licks less frequently if they have greater access to salty water. Yet, unlike the other domestic stock, camels need greater labour management skills. In addition, its value as 'a beast of burden' enables camel pastoralists to migrate over long distances usually averaging 15-20 kilometres daily. During such long trekks from one pasture to another, camels are relied upon to ferry domestic loads such as refabricated shelter, water containers, and food. A single camel can carry an average 100 kilograms.

Under the above strikingly harsh environmental conditions, camels and goats have been found to offer relatively better prospects for nomads' survival. Yet, it is somewhat surprising to realize that camel husbandry is the least developed despite its undisputed importance

in the arid and semi-arid ecosystems. What are some of the factors reinforcing this state of under-development?

Environmental Constraints to Camel Husbandry

The absence of camel statistics in annual publications of the Kenya Statistical Abstract, is a manifestation of the insignificant contribution camel husbandry is believed to make towards the Gross National Product (GNP). This under-development of camel pastoralism is, therefore, hypothesized to be partially a function of geographical phenomena of camels habitats.

The distribution of camel pastoralism in Kenya is restricted to the dry lands. These arid and semi-arid lands are geographically isolated due to poor communication network. Moreover, marginal resources of these regions have attracted minimal private and public investments, because of poor security. As a result of these factors, the dry lands have become regions of low priority under the previous national scheme of centralized development planning. It is hoped that, the new regional development strategy inaugrated by the office of the President in 1983, should accelerate the pace of development in the dry lands, because the new strategy emphasizes the district as the nucleus of development. In retrospect, the noted neglect which affected the general development of pastoral economies was initiated by the colonial government and perpetuated by the post-independence government until recently (Migot-Acholla, 1980).

Furthermore, the under-development of camel husbandry has been accelerated by the poor environmental perception camel nomads give the rest of Kenya's population regarding the economic value of camels. Probably, with the exception of Turkana pastoralists who have revolutionized their environmental perception of the value of the camel from a mere 'beast of burden' to a 'species of a cow' (Odegi-Awuondo, 1981), and the Gabbra who regard camel husbandry as the main-stay of their subsistence and a basic component in their cosmological order (Pratt and Gwynne, 1978), most of the other camel pastoralists have traditionally emphasized the rearing of camels as a 'beast of burden', or a means of supplementing diet and maintainance of cultural values. Yet, their rearing of cattle, sheep and goats has traditionally been also for subsistence and economic investments

including maintainance of social values. This proposition was endorsed by the study carried out among the Rendille of Marsabit district by Mburugu (1983). In his attempt to find out the most valued domestic animal among the Rendille, he concluded that "it is wrong to accept the impression given by Spencer that Rendille prize the camel to the point of excluding other stock. As a matter of fact, it would be difficult for the people to subsist on camels alone. Small stock are the almost exclusive source of daily food and the only source of cash for most households". In the same vein, another study carried out among the Samburu camel pastoralists found out that their social barometer of poverty was the number of cattle, sheep and goats a person possessed and not the number of camels (Ayiemba, 1983). It is, therefore, plausible to argue that camel husbandry is a form of environmental insurance policy which provides protection against risks, particularly, during periods of prolonged drought because of camels ability relative to that of other livestock to endure a prolonged drought.

Another significant variable contributing to the under-development of camel pastoralism is the poor environmental perception of its meat as a delicacy when compared to that of other stock. Whereas, camels meat is a delicacy in the Middle East (Frazil 1977), the absence of an official marketing system in Kenya, is reinforced by the fact that most people in the high potential areas of Kenya are prejudiced against camel meat (Ministry of Agriculture 1975, 1968). Furthermore, country wide consumer ignorance besides outright prejudice also affect marketing of camel milk. The situation is aggrevated by the unexpected poor perception of camel meat as a delicacy amongst camel pastoralists. Though these people utilize camel milk and blood, they rarely eat camel meat except on special social ceremonies. According to Pratt and Gwynne (1978), most nomadic pastoralists don't slaughter camels for meat though occasionally they feed on carcasses dying from natural causes. It is also expected that they resort to the eating of camel's meat only during periods of prolonged drought when the populations of cattle, sheep and goats have been reduced to a critical level for future take-off. It is, therefore, suggested that this tradition which value more camels' milk and blood is a national practice in camel husbandry in the context of their relatively low reproduction rate, i.e. calving after every two years. In addition, the generally high mortality condition affecting all calves constitutes a serious factor in camel growth rate, if one

considers the fact that their average life-expectancy is between 15 and 20 years only. The other factors contributing to the noted low growth rate are that males are sexually active only seasonally (rutting season), while the female's probability of conception during suckling of calf is almost zero (Pratt and Gwynne, 1978). This is a serious limitation in view of the awareness that conception occurs only during rain seasons. Surely, the total effect of all these factors could render frequent slaughter of camels or an organized commercial marketing very unwise. Therefore, the normal practice is to slaughter female camels at the end of their reproductive lifespan.

The under-development of camel pastoralism should also be conceived in the context of the insignificant proportion of the total nomadic population in relation to Kenya's total population size. According to the 1979 population census, the total population of six districts which are traditional camel habitats namely Turkana, Marsabit, Samburu, Mandera, Wajir and Garissa, was only 4.5% of the total population in Kenya. Note that, if the argument that camel husbandry among most of these nomads is accepted to be secondary to that of other stock, a proposition which is endorsed by Mburugu (1983), who found the mean number of stock per household unit among the Rendille was as follows: Camels (12.9); Cattle (11.3), Sheep (42.5), and Goats (43.5), then one should not expect to find a very large population of camels under such circumstances, especially, if other environmental constraints cause nomadic pastoralists to experience unfavourable political leverage with respect to political manoeuvres for development of their socio-economic conditions.

Lastly, with the exception of extreme arid zones in Kenya such as the rocky parts of Chalbi desert, there have been recent attemtps to sedentarize the nomads in their environments. These political manoeuvres under the Umbrella of modernization of the rural sector or provision of relief aids (Odegi-Awuondo, 1981) are definitely influencing environmental perception of the nomads value of camels as an economic asset, vis-avis other stock. There is increasing evidence that camel pastoralists are becoming more sedentarized as their traditional pasture lands become restricted (Schwartz, 1983). The immediate consequence is a reduction in the number of yearly migrations and the length of distances often covered. It is, therefore, proposed that these forces will in the

long run reduce dependence on a large number of camels as the preference for other domestic stock increases.

Conclusion and Recommendations

There is overwhelming evidence to support the notion that it is camel pastoralism which offers the best prospects for the management of the dry lands ecosystems in Kenya. Yet, it is unfortunate to realize that most of these arid and semi-arid ecosystems either have a very low density of camels or have no camels at all. It is, therefore necessary to carry out intensive transdisplinary research to analyse physical, biotic, and socio-cultural factors which are responsible for the under-development of camel husbandry in Kenya.

It has been argued that camels do not compete unfavourably with cattle and sheep for forage. But it is also known that camels compete seriously with the other stock for domestic labour. In fact, their labour requirements are more taxing. Research is therefore needed to help camel pastoralists identify a better environmental management system for grazing the two types of animals with different grazing requirements without necessarily interferring adversely with other domestic engagements in essential pursuit such as education and business activities.

Camels have also been noted to have relatively less resistance to diseases such as trypanosomiasis which can be spread, particularly among their calves by the other many different species of flying insects which are commonly found in their habitats. Research should be conducted to introduce new species of camels with relatively better resistance to diseases and with a relatively higher rate of reproduction. An attempt should be made to cross-breed the local species with Asiatic species like Camelus ferus which is wild in the Trans-Altai Gobi desert in Mongolia.

Consumer ignorance with regards to the nutritious value of camel milk especially among non-pastoralists in Kenya, as well as the other pastoralists who don't keep camels has been a major draw back in organized commercialization of camel milk. Massive consumer education and marketing research should be carried out to improve the situation. Lastly, the business people in the dry lands of Kenya could be encouraged to utilize more camels in transportation of goods.

Appendix 1. The Distribution of Cattle, Sheep and Goats in Selected Districts Between 1972 - 1977.

District	Cattle			Sheep and Goats		
	1972	1977	% change	1972	1977	% change
Samburu	448,300	249,800	-44.3	318500	409,000	28.4
Garissa	361,100	212,600	-41.1	74,200	293,200	295.1
Wajir	155,500	167,150	- 7.5	74,300	356,400	397.7
Mandera	80,400	29,700	-63.1	142,900	213,800	49.6

Source: KREMU (1977) Ministry of Tourism and Wild Life Publication Distribution and Densities in the Rangelands of Kenya.

FIG. 1 REGIONAL DIFFERENCES IN CAMEL DISTRIBUTION AND DENSITY

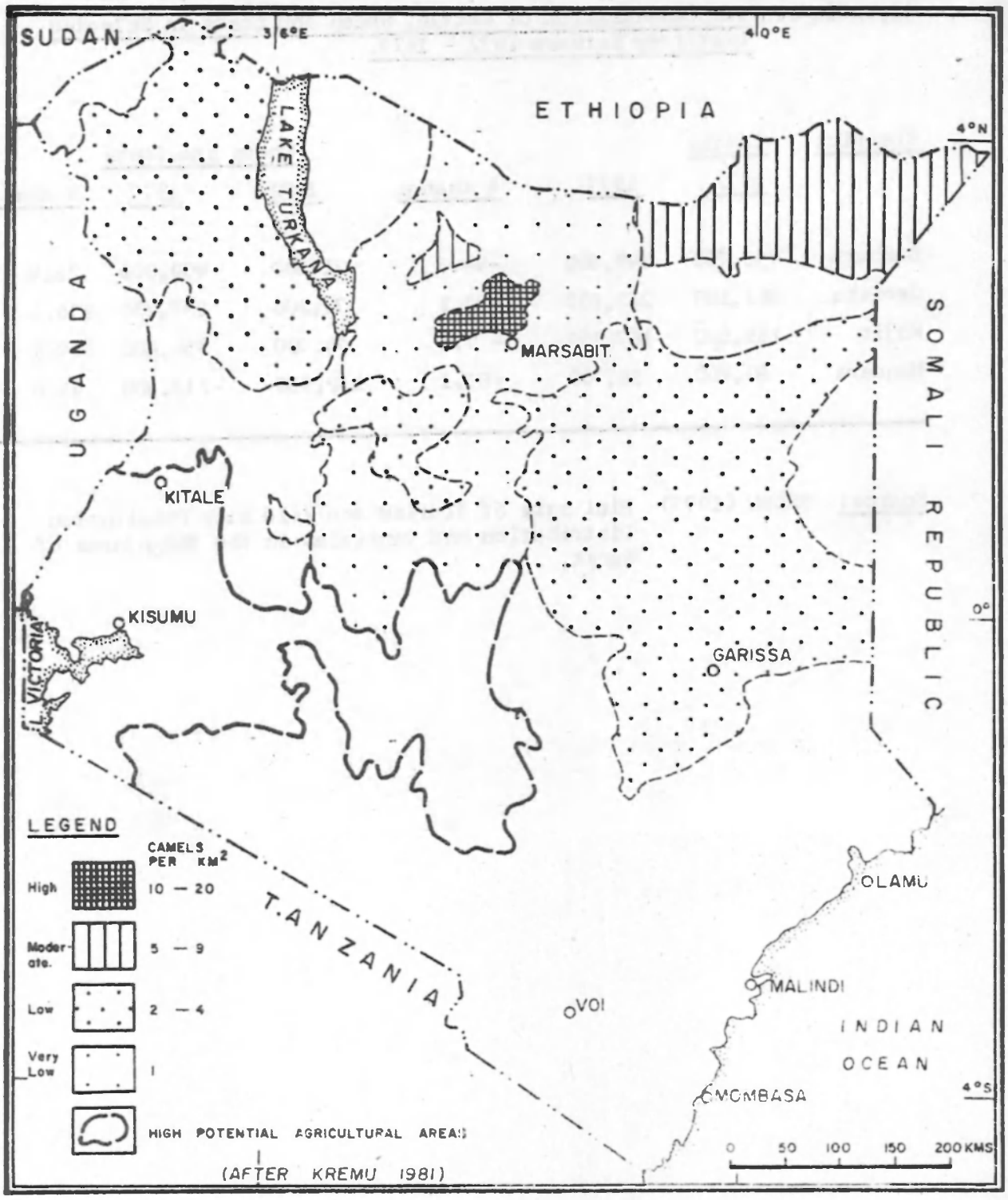
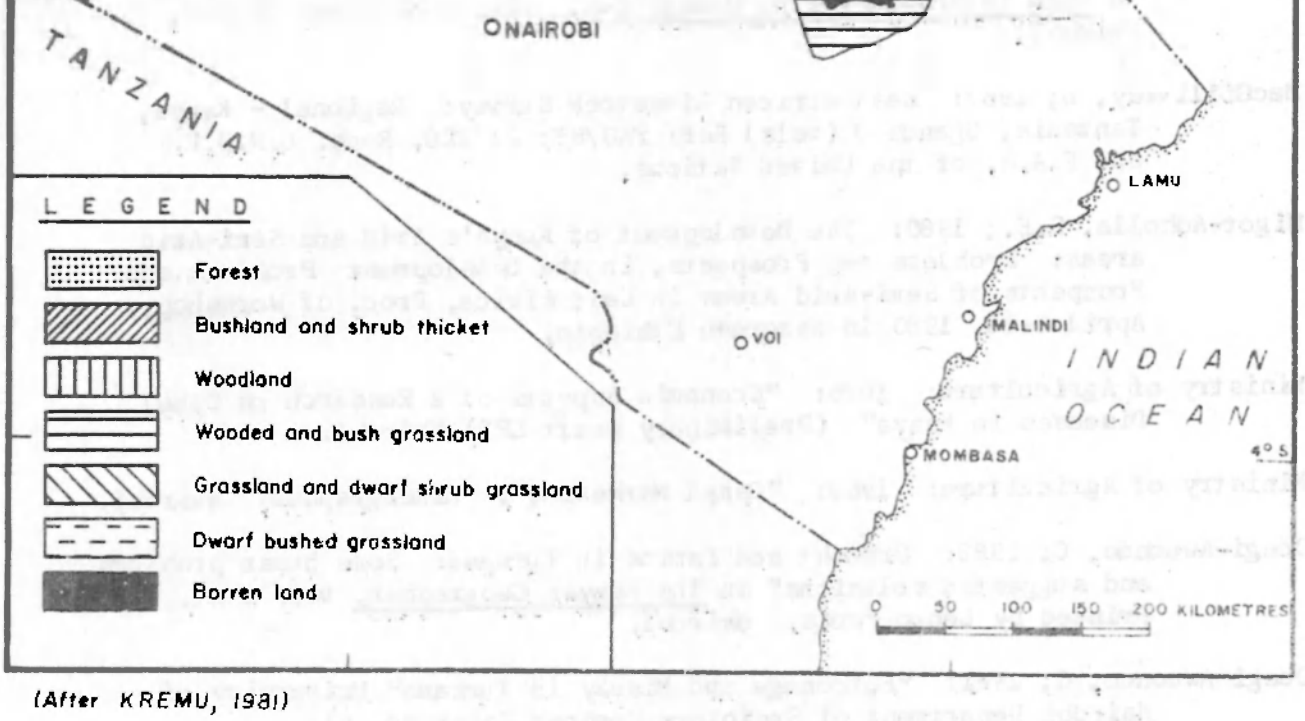


Fig. 2 **VEGETATION MAP OF KENYA'S DRY LANDS** (NORTH OF THE EQUATOR)



(After KREMU, 1981)

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Camel Pastoralism: The Kenyan Scene

by

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INTRODUCTION

The Camel

The Camel belongs to the ruminant family of even-toed ungulates. The other ruminant families close to the camel are the giraffe, okapi, the deer, cattle, buffalo, sheep, goats and antelope. The Camel is different from these ruminants in that it is pad-footed (they walk on pads instead of on the sole of the hoof) and it has no horns or antlers.

There are two types of camel; the one-humped (the dromedary camel) and the two humped (the bactrian) camel the two types however readily crossbreed and the crosses are mostly fertile in both sexes. The bactrian camel is woolier, shorter in the leg and darker in colour, and is more adapted to cold climates. The dromedary camel is the typical animal of the North Africa and the Middle East deserts - the ship of the desert, and is also sometimes described as the riding or racing camel.

According to Bremaud (1969), three breeds, varieties or types of camel can be identified in Kenya according to their natural breeding regions: the Somali camel (North Eastern Province); the Gabbra/Rendille camel (between Lake Turkana and Northeastern Province); and the Turkana camel (West of Lake Turkana). Table 1 gives Livestock population figures, including camels.

Table 1. Livestock Population

Province	Camels	Cattle	Sheep	Goats	Shoats	Donkeys
Northeastern						
Garissa						
MLD 1982	36,000	551,000	---	---	368,200	4,500
Mandera						
MLD 1982	111,000	92,000	---	---	394,200	3,100
Wajir						
MLD 1982	145,000	163,000	---	---	282,700	3,300
Eastern					---	
Isiolo						
MLD 1982	17,000	235,000	295,000	300,000	---	15,000
Marsabit						
MLD 1982	147,000	152,000	337,000	500,000	---	44,000
Rift Valley						
Baringo						
MLD 1982	2,700	175,000	300,000	615,000	---	2,600
KREMU MAR.						
1982	1,461	77,174	---	---	119,163	1,033
KREMU						
SEPT. 1982	1,562	97,453	---	---	177,537	2,901
Samburu						
MLD 1982	23,000	205,000	200,000	246,000	---	6,900
Turkana						
MLD 1982	108,000	147,000	500,000	600,000	---	177,000
KRE 1982	61,060	100,068	---	---	642,499	33,638
Ecosystems						
1982	99,800	158,100	---	---	1,142,300	77,700

Note: MLD - Ministry of Livestock Development

KREMU - Kenya Rangeland Ecological Monitoring Unit

Ecosystems Ltd - A Consultancy firm employed by the Turkana Rehabilitation Project

Shoats - Sheep and Goats

The Camel Region

The camel region in Kenya extends from the Uganda border to the Somalia Republic in the northern part of the country and from the foothills of the central highlands to the Ethiopian border. Within this region are the districts of Garissa, Mandera and Wajir in Northeastern Province; Isioloand Marsabit in Eastern Province; and Baringo, Samburu and Turkana in Rift Valley Province. These are the more remote, arid and less developed districts which constitute the camel region in the country. It is a region in which the major economy is pastoralism and the major natural resource is vegetation.

The Camel Ecology

The camel ecology or habitat is characterised by low and erratic rainfall, high evaporation rates, widespread suface water-run-off, and marked seasonal vegetation growth with recurrent droughts. The main vegetation types are thorny - bush complexes of Acacia/Commiphora, along with Cenchrus/Chloris/Chrysopogon grasses. Although trees abound in the arid areas, forest areas are few and are mainly located in uplands, where the rainfall is above average and/or mists frequent. Table 2 gives population density and land area of the arid districts.

The Camel People

The pastoralists in the arid areas of Kenya belong to two major linguistic groups - the Cushitic: Somali (Ogaden, Degodia, Ajuran, Aulian and Gurreh), Galla (Orma or Oromo, Borana, Sekuye), Shangilla, Gabbra, and Rendille. The Nilo-Hamitic: Turkana, Samburu (Loikop), Njemps, Tugen and Pokot.

These are the ethnic groups which are primarily a cattle-owning people and who also herd sheep, goats and donkeys. Some of the groups have had camels for a long time, others have acquired camels only recently, and still others are traders and/or cultivators. For example, according to Bremaud "the Somali, who once were camel-raisers, abandoned this practice during their north-west/south-east migrations, when they came upon conditions favourable to other domestic species." Somali groups in the Northeastern are thus herders of camels and those in the south keep large herds of cattle, sheep and goats, but camels are still of very great importance in the economy. Somali are also

MAP OF KENYA SHOWING DISTRICT BOUNDARIES

very keen, dedicated and able traders, Borana have only acquired camels of recent times, while Galla/Gabbra are primarily a cattle-owning people, with a pastoral economy mainly based on camel, or camel and goat husbandry. Turkana herd cattle, sheep, goats, donkeys and camels, but do not use the latter very much for transport purposes. Samburu like the Borana, have only of recent times acquired camels and they are also cultivators. The Njemps, Tugen and Pokot are primarily cattle people but also cultivate. The case of some groups of Somali abandoning camel raising and other groups like Borana and Samburu acquiring camels only of recent times would confirm the general rule that, "nomads from barren regions abandon camel raising as soon as they have access to land that is favourable to different kinds of pastoral speculation", and those from favourable land acquire camels as soon as the conditions become more barren and unsuitable for other domestic animals; e.g. the Pokot people who have recently turned to camel raising.

The total number of people in the arid districts has increased by 29.4% over the 1969 population, but this is still 10.5% less than the increase in the total population of Kenya of 39.9%. The population of the districts has, therefore, fallen from 6.6% in 1969 to 6.1% in 1979 as a percentage of the total population of the country. Population growth has been least in these arid districts and the relatively high population increase in some of the districts (Table 3) is due to immigration from the surrounding districts. The increase has also been due to the inherent lower annual rate of population growth among the imigration pastoral populations, and to droughts and security risks in their areas. Table 3 gives population census for 1969 and 1979, increase and growth.

What others say about the camel

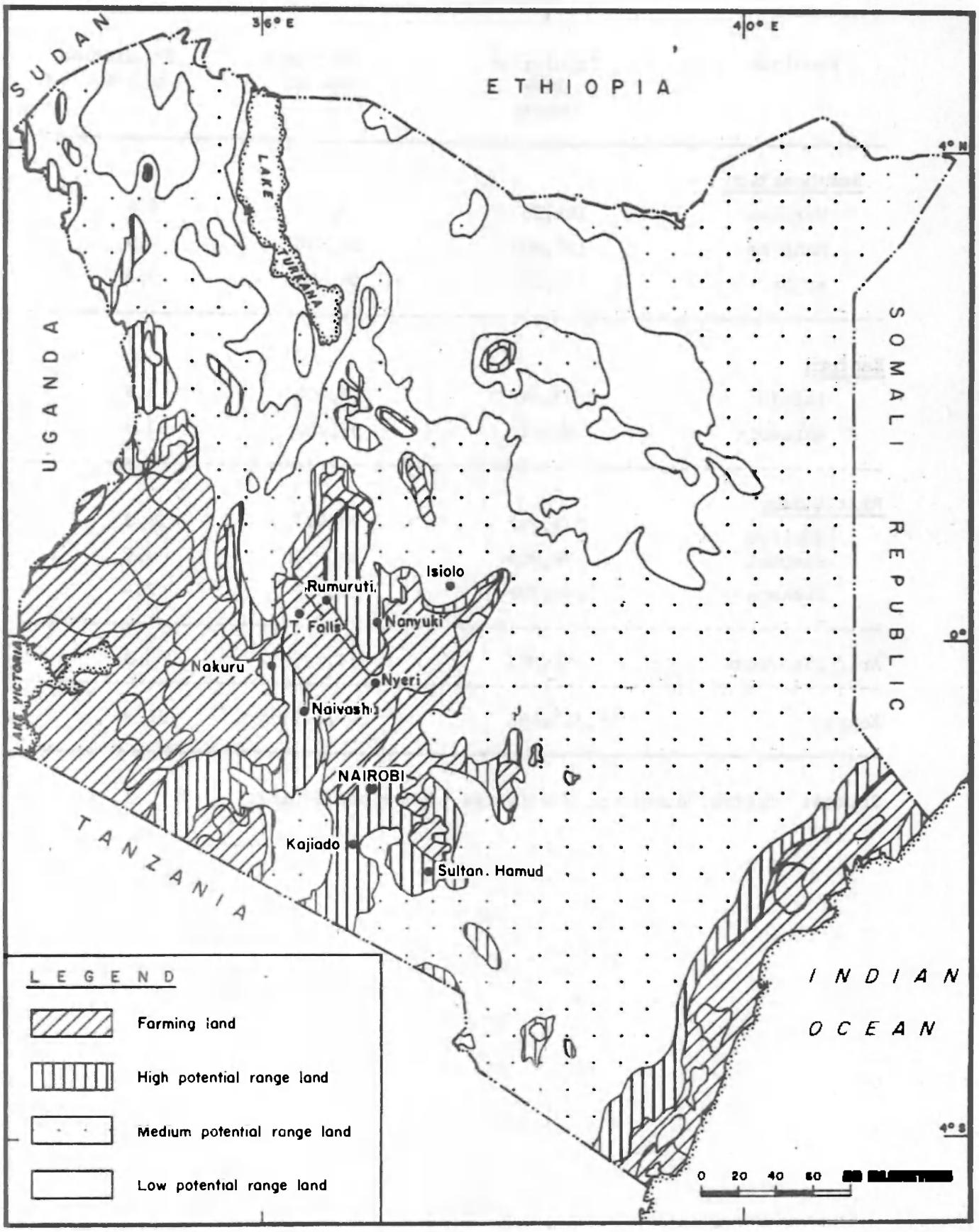
In the letter of invitation to participants in this symposium, the opening sentence stated that, "Camel pastoralism has for two thousand years formed an important part of the survival strategy of many African nomads. Yet relatively little is known about the cultural and material base of this form of subsistence." Little may be known about the survival strategy of many African nomads, but a substantial amount of information would appear to be available and what is needed now is putting the information together and making it available to a wider audience. To do justice to the few enterprising

Table 2: Population Density and Land Area of the Arid Districts

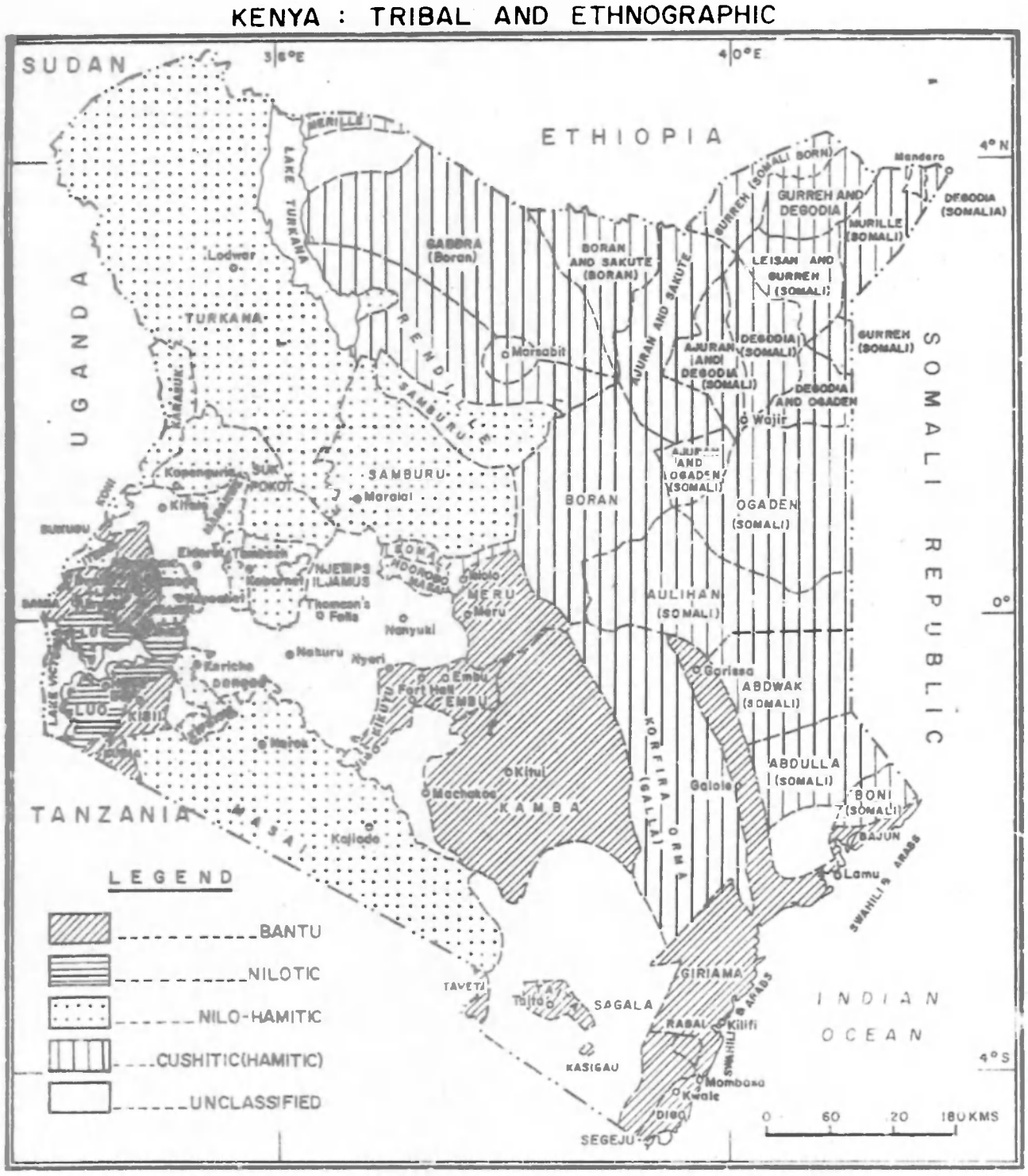
Province	Population 1979 census	Land Area Sq. Km	Population per sq. km
Northeastern			
Garissa	128,867	43,931	2.9
Mandera	105,609	26,470	4.0
Wajir	139,319	56,601	2.5
Eastern			
Isiolo	43,478	25,605	1.7
Marsabit	96,216	73,952	1.3
Rift Valley			
Baringo	203,792	10,627	19.2
Samburu	76,908	20,809	3.7
Turkana	142,702	59,490	2.4
Arid Districts	936,891	317,385	3.0
Kenya	15,327,061	569,137	26.9

Source: Central Bureau of Statistics (1981a and 1981b).

~~Fig.~~ MAP OF KENYA SHOWING AGRO-ECOLOGICAL ZONES



KENYA : TRIBAL AND ETHNOGRAPHIC



individuals and institutions which have gone out of their way to carry out investigations and collect data on camel and its pastoralism, and to give compliment where it is due, this paper will attempt to highlight some of the available written information on the camel, or we may ask what is the nature and scope of the available information? What are the conclusions, the advice and recommendations?

Bremaud made an exhaustive study of camel production in Kenya in 1969 which involved:

(a) a detailed study of camels and their potential in the camel regions of the country, including the possibilities of reproduction, marketing and distribution.

(b) identification of the camel population to assist with the implementation of camel production programmes.

(c) advising on the problems relating to camel production, including feed, reproduction, calving rates, age of slaughter for domestic consumption, marketable products (meat, milk and hides), age for breeding, mortality rate and its main causes.

(d) providing a general impression of the physiological and environmental factors causing low productivity rates and recommending methods for improvement.

Time did not allow for a complete study, but the result of the study is not only commendable but has been a reference material on camel production in Kenya for sometimes now. Worthy of note are some of the conclusions, advice and recommendations coming out of this study: As far as Kenya is concerned, it is only in the Northeastern Province that the camel finds its way into a market economy through Somalia. To the west there is no outlet for camelsand camel products, yet the camel is the basis of a subsistence production. Secondly, the optimal conditions for camel production seem to have been reached, considering the prevailing environmental factors. It would therefore appear that other domestic species will be replaced on pastures that are already denuded, if the natural camel grazing boundaries are exceeded. Stiles (1983) would appear to agree with the foregoing when he points out that the change in the tradition of the Samburu (traditionally cattle people) to acquire more and more camels, to reduce their dependence on cattle will be to the good of the ecology, if the natural camel grazing boundaries are not exceeded. It would, therefore, be reasonable to conclude that the infliltration of camel into areas outside their natural regions, including Samburu, is mostly

limited to over-grazed areas, where raising of (especially) cattle has become a risky speculation. Thirdly, never attempt to raise camels on a farm or study the problems of camel raising on an experimental station: grazing lands on farms, though situated in camel regions, lie within cattle-breeding areas and are composed of over-grazed pastures that are useless for camels; camel raising is of interest only if it allows exploitation of land on which other species cannot be raised; and natural feed that costs nothing is essential for raising camel, since profits on camels are not that substantial. Finally, before a camel programme is planned in details, a series of studies and inquiries must be undertaken to provide the precise information to avoid orientation errors.

At a Workshop on camels held in Khartoum, Sudan in December 1979 and sponsored by International Foundation for Science (IFS) some of the most relevant and professional papers on all aspects of camels were discussed. However, although the papers presented and discussed covered all the aspects of the camel in the widest context possible, it is a pity that out of some twenty eight (28) papers only four (4) are specific to Kenya. The topics covered include: the origin and history of the camels; nutrition, production and reproduction; physiology and adaptation; and pathology (disease) and sociceconomic importance of camels.

On the Kenyan scene, a paper by Evans and Powys discusses camel husbandry to increase the productivity on four ranches, which extends camel rearing beyond their natural habitat. But as an experimental undertaking let us see the results of the study. It is reported that: the camels proved to be complimentary to other livestock; having different and more versatile feeding habits; they adapted well to changes of habitat and suffered from few ailments; management was comparatively cheap and easy; they showed economic promises; and they were pleasant to work with. The only draw-back noted was their slow rate of reproduction. A total of 252 camels had been acquired between 1974 and 1978. Another paper on Dromedary Pastoralism in Africa and Arabia by Dahl and Hjort is a very valuable piece of literature on camel pastoralism; the paper is detailed, informative and purposeful, particularly with reference to camel pastoralism in Kenya. The paper discusses the restrictions inherent in camel-based pastoralism

Table 3: Population 1969 and 1979 Percentage Increase and Estimated Annual Rate of Population Growth

Province	Population 1969	Population 1979	% Increase In Population	% Annual Rate of Growth
Northeastern				
Garissa	64,521	128,867	99.7	7.16
Mandera	95,006	105,609	11.2	1.06
Wajir	86,230	139,319	61.6	4.91
Eastern				
Isiolo	30,135	43,478	44.3	3.73
Marsabit	51,581	96,216	86.5	6.43
Rift Valley				
Baringo	161,741	203,792	26.0	2.34
Samburu	69,519	76,908	10.6	1.02
Turkana	165,225	142,702	-13.6	-1.29
Total Districts	723,958	936,891	29.4	
Total Kenya	10,956,501	15,327,061	39.9	3.41
Arid Districts as % of Total Kenya	6.6	6.1		

Source: Central Bureau of Statistics (1981a)

(seasonality of production and labour requirements) and camels as producers of staple food and as a means of obtaining political control. A paper by Schwartz reports on the role of the camel as a transport animal in the pastoral economy of the Rendille of Marsabit District, Kenya. The main conclusion is that the number of loading camels available per nomadic household is a major factor determining: the mobility of pastoral groups; the choice of the seasonal pastures; and maximum utilisation of the reproductive potential of the nomad's herds.

The foregoing is presented to indicate that, with a more detailed review of available literature on camels, including the long list of references given and cited in the papers presented at the Workshop, the possibility is there of amassing valuable information on camel subsistence and camel rearing, although it is not known for certain whether this information is based on anthropological efforts towards more general studies of camel pastoralism.

Camel Pastoralism

Pastoral Economy

Cattle are not the most important economically, but they are the most important in shaping life patterns in camel pastoralism. Camels are important economically but only in a limited area in the northeastern and northwestern Kenya. In general, the pastoral economy is constrained by such factors as: climate, to which the economy must adjust; security and rustling, that could be eliminated with some will and means; inadequate services for both livestock (marketing) and human (social); traditional cultural attitudes; and lack of relevant and coordinated development projects particularly camel projects.

Pastoral economy can not support a heavy human population, but the pastoralists should continue to receive some priority in development assistance; it is the only economy in this region which currently: fully exploits the major natural resource of the arid rangelands; provides subsistence and employment for the people of the region; is capable of generating substantial wealth as livestock and livestock products; and is capable of decline if not restructured and developed, resulting in range resource degradation and destitution of the pastoralists.

Pastoral Crisis

Nomadic people have, for thousands of years, grazed their herds over large areas of arid and marginal lands which grow only sparse vegetation suitable for livestock including camels and wildlife.

Williams (1983) believes that there is a pastoral crisis because the ecological viability of traditional pastoralism and of the land itself are threatened as a result of governments restricting the mobility of pastoralists, thus limiting the regions they may use. He argues that international livestock consultants have tried for 60 years to impose sedentary range management on Africa's nomadic herders with little favourable results. Also, the World Bank and USAID have spent US$ 650 million on livestock programmes on the continent without much success.

The impression given here for the unfavourable results and the unsuccessful livestock projects, inspite of the huge amounts of money provided by donors, is that governments in Africa restrict the mobility of pastoralists and thus limit the area of use. It is accepted that there are scientists and sociologists who would vehemently defend this premise, but let us look at two other possible contributory factors; that is,coordination of development projects and decision making.

The Government of Kenya has, with effect from July 1, 1983 delegated to the districts the responsibility for the operational aspects of district specific rural development. This is because there have been a very large number of operational development projects in the pastoral areas, but these lacked coordination at both national and district level. The objective is to broaden the base of development responsibility, encourage local initiative, hopefully increase efficiency in project implementation, provide increased responsiveness to the requirements of the local population, and provide for dialogue and cooperation with the pastoralists themselves.

Also, it is generally accepted that, in many instances of development planning, pastoralists have been left out of the decision-making process, even with the understanding that, in development planning, it is essential to gain acceptance of chosen

development strategies by the local population. The failure of many livestock development projects has been blamed on these factors, because it is not enough to make a lot of money available for projects if the strategies adopted are not acceptable to the people to be developed, and if a continuous dialogue and cooperation with them is lacking.

Samburu is not a very arid ecology but it is running out of grass, the staple food of cattle. The Samburu people have, of recent times, made an all-out effort to acquire more camels and thus move away from full dependence on cattle. With much of the grass in the uplands, the Samburu have made a decision to rear more camels to utilize the Acacia woodland and other sparse bush which dominate the low-lands and provide a suitable vegetation cover for camels. Also, the increase in human population in the district has increased the demand on the number of the domestic animals necessary for sustained subsistence. Now, the question is: Is camel ownership an indicator of and an adaptation to an increasingly arid environment? Is the slow movement of camels over centuries from north Africa to recent movement within Lake Baringo an indicator of a corresponding increased movement of aridity from north Africa to the south and also an indicator of a pastoral crisis?

Species Diversification

Diversification of herds, where one herd-owner keeps more than one type of domestic animal, is the most common way the pastoral tribes reduce risks in their pastoral life. This is in recognition by the pastoralists of the advantages of having mixed herds; that is, mixed products, different but complimentary lactation patterns; quick monetary returns on small stock; minimised disease risks; different but complementary grazing habits; and different watering needs and habits. As a rule, therefore, a limited number of camel herdsmen keep all the types of livestock (cattle, sheep, goats and camels) and most try to keep at least three types (cattle, sheep and goats).

Subsistence Production

Subsistence production of camel rearing has a main objective of providing camel products to meet the family requirements of a pastoral society, such as milk, meat, fat, leather and work. Camel milk is the staple of a camel herders diet, and practically all the

milk is consumed on the spot and the camel calf and the herder are most of the times in competition for it. Camel meat in urban areas of the districts is rare, perhaps because the urban population prefers the meat of other livestock to camel meat. Also as a rule, many camel herders from the camel rearing ethnic groups do not market their animals for slaughter and the subsistence camel production, in the pastoral environment, is therefore more significant to the camel herder than the economic production.

The composition of livestock that the pastoralists look after differ from district to district but camels constitute a larger proposition of herds in the more drier districts (Mandera, Wajir, Marsabit and Turkana) whilst cattle are more prominent in the herds found in the districts with more reliable rainfalls (Baringo, Samburu and Isiolo). Grazing areas are allocated according to suitability of vegetation for each type of stock; camels are allocated the grazing further from the camp. Pastoral tribes usually split the animals into milk and dry herds or according to species - cattle, sheep and goats, and camels or alternatively, cattle/sheep and goats and camels/ sheep and goats.

Camels tend to be more evenly and densely distributed, particularly where increased human activities persist. In Turkana, there are therefore many areas with camels and no cattle but very few areas with cattle and no camels. The herds are grazed together during the rainy seasons, but are split into smaller units soon after the rains - the cattle being sent to the hills, the small stock to the foothills and the camels continue to graze adjacent to the main camps. In the districts of the Northeastern Province all the herds migrate together, though they may be split into small units.

Camels usually graze the unused area far away from water sources due to their ability to stay without water, or stay away from water for longer periods of time. Salt is essential for camels and "the balance between salty and unsalty browsing" is one of the most difficult parts of camel-keeping. Generally, camels have to get a salt cure six to seven times per year or they will grow thin and not rut. It is believed that camels which are allowed to browse the acacia (particularly in Waiyama areas in Isiolo District) multiply quickly, as they must be taken to the areas at least every six months (Dahl and Sandford, 1978).

Socially, the accummulation of stock against risks of drought, rustling and disease, and livestock as a source of food will continue to rank very high in importance among the pastoralists and particularly so among the Rendille, where camels are replacing cattle as status symbolsand as bride price. Most of Rendille herders would want to own camels, sheep and goats and only a few consider cattle as important. This is because the camel is an important and significant factor in pastoral social structure and forms a basis for many social contracts. On the other hand, the Rendille also recognise the value of small stock as exclusive source of daily food and the most important source of cash.

In a study by Mburugu (19 ?) titled Households' Livestock Management in Relation to Population Movements and Land Use Practices Among the Rendille, the results of the study indicate a high probability that 52% of the 113 households of the Rendille who valued stock as a source of food and cash had small stock in mind and that 33% who valued stock because of their hardiness had camels in mind. Nevertheless, in Rendille the use of livestock for economic investment (accummulation of numbers against risks) and bride price have superceded the use for social status. Table 4 relates the value of camel, cattle, sheep and goats as a per cent of the economic and social importance.

The role of the camel is probably best potrayed by the following extract of a song* in praise of the camel among the Somali of Northeastern Province:

> In time of drought, to provide milk, you are rival to none. Sheep and goats will die and cows cease to produce, but dear camel will not only survive but will continue to give us milk.
>
> When we have debts to pay, whoever pays with goats and has paid ten of these already. With my camel, with only one I will surpass one who paid with goats by an equivalent of ten.

---

* Source: R.M. Muriuki, MALD, Garissa.

The proud father of beatiful daughter
will find best value, if I give him camels.
The girls too will appreciate the exchange value,
as cattle, sheep and goats will be no match.

In times of danger and haste, I am fast to act if
I am fed on camel's milk. Cows milk in my stomach
will curdle, to make me slow and prone to danger.
But camel milk keeps me healthy and active.

The camel will give milk four times a day, even in the dry season, but its reproduction rate is considerably slower than that of cattle. The initial recovery after drought, disasters and raids is usually more difficult, especially considering that although a lactating camel produces large quantities of milk the interval between one lactation and the next (gestation period) often exceeds one year. In addition, it takes between 5 and 6 years before a young female camel can produce milk, even under favourable circumstances.

The average number of livestock of all ages per household (7.27 people on average of all ages and sex) was found to be: camels 25.8; cattle 22.6; sheep 85.0; and goats 87.0 (Mburugu). The outstanding attributes of the camel; e.g. ability to make use of the abundant leaves on trees and shrubs, left behind by browsing goats and wildlife; their lower reproduction rate, which suites the ecology; their mobility and capacity to endure long periods without water; and their efficiency as transport animals have endeared them to many pastoral tribes. Unfortunately, these attributes have also made them more attractive to Shifta bandits in the Northeastern Province, where they have been more frequently stolen than cattle.

Marketing

The prolonged state of insecurity in the Northeastern Province, caused by Shifta and sometimes by in-fighting among some of the ethnic groups, has precluded any serious consideration of the camel industry. However, it should be realised that since cattle prefer grass and camels prefer bush, the two are complimentary and the development of commercial camel production should not inhibit cattle production, as it will do nothing else but increase the total productivity of the area. The important information which is required for supply of camels for marketing but usually lacking include: breeding behaviour; herd composition to calculate accurately the

Table 4: Importance of Livestock as related to Percent Households (Rendille)

Type of Importance	Stock	Very Important	Important	Not Important
Social Status	Camel	70.8	8.8	6.2
	Cattle	10.6	47.8	7.1
	Shoats**	44.2	28.3	3.5
Social Contacts	Camel	28.3	8.8	35.4
	Cattle	61.1	20.4	4.4
	Shoats	43.4	49.6	1.8
Economic Investment	Camel	27.4	23.9	12.4
	Cattle	64.6	12.4	9.7
	Shoats	55.8	29.2	3.5
Bride Price	Camel	92.8	2.7	1.8
	Cattle	31.0	58.4	1.8
	Shoats	3.5	24.8	56.6
Source of Food	Camel	25.7	7.1	16.8
	Cattle	22.1	21.2	15.9
	Shoats	97.3	0.9	----

Source: Mburugu

* = Total number of Households 113

** = Sheep and goats

optimum offtake rates and proportion of offtake consumed by the owners and that offered for sale. It is considered that an offtake of 10% per annum would be optimal, and the number sold will almost certainly show an increase in the dry seasons, which is normal for nomadic pastoralist stock sales.

In order to maintain a regular supply of camels, it is necessary to establish proper facilities, holding grounds and routes. There is no evidence to show whether the camel population is stable or variable, apart from the possible reduction of herd population by Shifta. It is reasonable to assume that the population is not decreasing and that the numbers to be offered for sale will remain fairly constant, and any increase will be gradual as the camel is a slow breeder.

Extension Education Research

The camel is a domestic animal just like a cow and can therefore be bred for higher milk yields and meat production. So far little or no work has been carried cut on camel research in Kenya. Livestock production extension workers have had little to extend to camel herds for lack of research results.

Sooner than later, as the population in high rainfall areas become unbearable there will be a spill-over into arid areas (the camel region). To be able to develop the resources of these areas, to produce food to feed the additional population, we need to equip our future extension workers with the necessary knowledge through research and education.

Conclusion

The Livestock extens ion worker is currently poorly equipped to deal with the development and problems of the camel. Past neglect of this very important pastoral resource should not be allowed to continue as there is much that can be done to develop the camel to meet human needs of food and money. All of us who have some interest in the arid rangelands, both Government officers and the pastoralists, must do something towards camel development and soon.

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CAMEL PASTORALISM IN KENYA: EMPHASIS ON MARSABIT DISTRICT.

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Introduction

The lukeworm concern for camels so far shown by planners of livestock policies sharply contrasts with the towering place camels occupy in the life of pastoralists of Marsabit District and North Eastern Province. Climatic and forage conditions are more suitable for camels. The beasts can go for two weeks without water, and cover more than 50 km. to reach a water source. Camels are mostly browsers compared to cattle which are grazers. If markets could be found, particularly in the middle East, camel raising in the areas could provide an additional contribution to the gross national product, and to that extent promote the welfare of the pastoralists. That apart, it ought to be recognized that in their socio-economic set-up the pastoralists use the camels to provide, first and foremost milk, then transport for fetching water and moving homes. Whenever they are slaughtered, they provide meat, and hides for making homes. The camel is life to these pastoralists.

Camel Distribution in Kenya

For most Kenyans, when one talks of camels, they have in mind the North Eastern Province, inhabited by the Somali ethnic group. A few others will have in mind Marsabit district, at times assumed to be part of N.E. Province. Few planners have seen camels at close range. Thus there appears to be some mis-information about the camels and their distribution in Kenya. Table I shows where camels are largely found in the country.

Table 1: Estimated Camel population in Kenya.

Province	District	Camels	Sub-total
Rift Valley Province	Baringo	2,700)	
	Turkana	113,000)	123,200
	* Samburu	7,500)	
Eastern Province	Isiolo	22,000)	182,000
	+ Marsabit	160,000)	
North Eastern Province	Mandera	111,000)	
	Wajir	145,000)	292,000
	Garissa	36,000)	
	Total		597,200

Sources: (1) Compiled from Annual Report, Animal Production Branch (1981) and Annual Report Ministry of Livestock Development (*) Turkana District for 1980.

(2) * Socio-Cultural Profiles Project (1982) Samburu District, Institute of African Studies, University of Nairobi (Draft Report.)

(3) + Wandera et al. (1982).

Apart from the 8 listed districts, there are a few hundreds of camels found in West Pokot, Kitui and Tana River districts. In Baringo district the camels are in Nginyang division to the northmost part of the district - inhabited by the Pokot ethnic group. Camels in Samburu district are concentrated in Baragoi division which neighbours Rendille country of Marsabit district - from whom they acquired them. There was a time when Isiolo district was reputed to have many more camels than the presently estimated numbers. While the Turkana keep over 100,000 camels, mostly for milk (and not for transport - where the donkey is used), the inhabitants still value cattle most.

Most camel (and other livestock) counts in many parts of the country are not very reliable, particularly in the arid and semi-arid lands. The persistent drought and the ensuing constant movement of livestock in and out of the district, make it difficult to carry out any meaningful census of livestock. Such an exercise to be reliable, would cost a lot of money, and whose value in terms of priority would be hard to justify.

Number variations by different sources are to be expected. Where available, figures given by the Animal Production Branch tend to be over-estimated compared to those of the Range Management Division - though both belong to the same Ministry. Thus the total figure of 597,200 camels in Kenya by the early 1980's may have an over-estimation element of between 20-25 per cent. The figures of 450,000 - 500,000 may be more realistic, and more valuable for purposes of planning.

General Remarks on Marsabit District

Amongst the nomadic pastoralists of Marsabit district, land belongs to the various ethnic groups (Wanjala, 1982) for the purpose of grazing and browsing their livestock, and settlement. The demarcation lines between the groups are mainly for administrative purposes, as they cannot be strictly observed. No individual claims ownership of any area of pasture. The borders of the ethnic groups tend to conform to the divisional ones. The Rendille and Samburu are mainly found in the Laisamis division to the south. The Gabbra, Shangilla and Turkana live mostly in North Horr division - situated north of Laisamis, while the Borana, Sakuye and Burji are to be found in Sololo and Moyale divisions. The Mountain (Marsabit) division has a mixed population - mostly agricultural. The major ethinic groups of Marsabit district according to 1979 census, are the Boran (30,444), the Gabbra (23,410) and Rendille (19,856). From the study of Sobania (1979) these ethnic groups and a few minor ones came from southern Ethiopia and possibly the Republic of Somalia dating about the second half of nineteenth century, but that they started receiving Kenya Colonial Government protection from the beginning of this century. The Sakuye, a minority group, who at one time had camels as their main property have largely been assimilated by the Boran of Moyale and settled in Dabel. They practise transhumance for their animals in the dry seasons.

Marsabit district is still regarded as remote and perpetually drought - stricken. Because of the enormous size (78,078 sq.km. or more than double the size of Central, Nyanza and Western Provinces combined) of the district and hence long distances one has to cover from one settlement to another, on some of the poorest roads, few

policy makers or implementers from Nairobi ever go there by road. The author (and his research team-mates) had a limited experience of the district during July, 1982. To cover the 270 km. from Isiolo to Marsabit on the rough, rugged, stony and dusty road was learning about a part of Kenya. Driving over rocks, boulders, and barren land to Maikona and through Kalacha, the Chalbi desert to North Horr - a distance of over 160 Km, and sleeping outside under the stars and continuous strong winds was part of the learning experience. The same rocky, stony and rugged road takes one to Loiyangalani, then to the top of Mt. Kulal at Gatab and along a really sandy road to Kargi before starting on the rugged road once more back to Marsabit town, having covered over another 200 km. in the process. The road Marsabit to Moyale, a distance of over 260 km., is just as interesting from its physical features and by the time one has gone through Dida Galgallu, Turbi, Sololo and back, a better appreciation of life in the district will have been acquired.

Most of the district is unsuitable for crop agriculture due to aridity and vast extent of rocky, stony, rough and rugged lava plains with poor soil development. Marsabit district is the driest area in Kenya, it experiences erratic rainfall, which also varies significantly both over a single year and over successive years. The district, apart from Mts. Marsabit and Kulal, and Moyale, experiences high temperatures, with mean annual temperature of 29°C., and a maximum of 45°C. in places like North Horr. There are no permanent rivers. Water is very inadequately provided for in the district. Without it, there is no development work on crops, livestock and afforestation.

Because of the prolonged drought, the frequent failure of seasonal forage and hostility of neighbouring ethnic groups, the inhabitants have adjusted to a nomadic pastoral pattern for their livestock. They move herds to locations where adequate vegetation is available. By instinct the pastoralists are aware that their food animals transform energy stored in forage (grasses, herbage, shrubs and trees) of the area into the people's staple food - milk and blood, and meat during ceremonies and when other forms of food are in short supply, particularly during the dry season.

Apart from donkeys which are used as beasts of burden, the 4 main species - camels, cattle, goats and sheep are used to provide food. Additionally, camels and cattle are the most significant in dowry. Amongst the Rendille dowry, traditionally, involves 8 camels (and a few cattle) of which at least one must be a lactating camel. Table II shows the livestock species found amongst the Marsabit nomadic pastoralists and estimated population between 1971 and 1982. The size of the district, climatic factors and security problems make it impossible to carry out meaningful census. Secondly, the well-known reluctance of the part of the pastoralists to divulge information on their livestock sizes compels the administrators and planners to rely on estimates.

The Camel in Marsabit District.

The majority of Marsabit people have an emotional and economic commitment to herding, particularly large stock (cattle and camels.) This property represents food for survival - milk, blood and meat, as well as wealth, social status and by extension influence.

In both Moyale and Sololo (neighbouring North Horr) divisions camel herding is insignificant as the Borana inhabitants are mainly cattle people, with some goats and sheep. It is in North Horr, the biggest and driest division in Kenya, where most of the camels in Marsabit district are found. The Gabbra people who inhabit the division also have the highest population of goats and sheep, with some cattle. Amongst the Gabbra, every family keeps camels, goats, sheep and a few head of cattle. In Rendille country, Laisamis division, the highest number of cattle in the district are to be found. They also keep goats, sheep and camels, and the highest number of donkeys.

About half of the people of Marsabit (Wandera, et al.1982) district rely upon the camel for their primary food supply - milk, even though the acquisition of these animals is a recent thing. Camel blood and meat are occasionally consumed, mostly from bull camels, poor quality males not used for breeding and old, weak females. Slaughtering of a camel is a major decision made by the head of the family. Traditionally, female camels are exempted from slaughter, trade, exchange or transport work.

Table 2: ESTIMATED LIVESTOCK POPULASTION OVER SOME YEARS

MARSABIT DISTRICT

IDS/OP 45

Livestock Year

Species	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
Cattle	200,000	147,000	140,000	125,000	130,000	131,600	393,900	434,390	456,100	410,500	415,000	450,000
Goats	305,000	241,000	240,000	235,000	230,000	253,000	463,900	510,290	535,800	509,200	519,100	560,000
Sheep	203,000	160,000	150,000	145,000	140,000	168,000	464,000	510,400	535,900	509,100	519,000	556,000
Camels	140,000	132,000	130,000	-	-	110,000	134,000	147,400	154,800	157,900	159,100	160,000
Donkeys	-	5,000	4,000	-	-	3,300	17,200	18,920	19,900	20,300	20,500	20,000

Source: Compiled from the District Annual Report; Ministry of Agriculture/Livestock Development, Marsabit and Data collected by the author while on a Socio-Cultural Profiles study of Marsabit District July 9-27, 1982.

Camels are used to carry water, approximately 80 litres each from the water source to the settlements. Camels observed at Maikona springs and oasis at North Horr (Wandera et al. 1982) were each carrying four water-containers, two on either side. The durable containers were made from Giraffe-hide whose outside was artistically woven with specially made ropes from the bark of certain trees. Camels are also used to move houses and other household goods when shifting to a new grazing area, except amongst the Rendille where the donkey is increasingly being used.

Herding Patterns of Ethnic Groups

Traditionally and for several generations, the Gabbra (Sobania, 1979) occupation in the present Marsabit district was limited to the Huri Hills and the plains of Dida Galgallu. These waterless areas were used after the first rains fell. They then trekked back into the well-watered plateau areas of southern Ethiopia. Presently the Gabbra have 4 grazing areas for their herds within their North Horr division. Their movements are determined by the availability of forage, water and security. There are dry season grazing areas and wet season grazing areas. The forage is made up of annual grasses, dwarf shrubs and shrubs in between barren land or bare rocks. The good forage on Huri Hills and Dida Galgallu cannot be taken full advantage of because of lack of water.

The Rendille country is also made up of annual grassland, dwarf shrubs and bushland (Lusigi, 1981) equally suitable for camels, goats, sheep and cattle. There are also 4 areas where the Rendille base herding of their livestock influenced by rainfall, water and security.

The majority of camel herding ethnic groups are now found in semi-permanent settlements where water and security are more easily assured. Maikona, Kalacha, North Horr and Dukana are amongst the Gabbra settlements. Karogi, Korr and Laisamis are some of the Rendille settlements. Consequently the camels are divided into lactating and dry herds. The milking and transport herds are kept near the settlements, looked after by women and

small children. Young unmarried women fetch water for human use in the semi-permanent camps, with the transport camels at the water points. Between 20-30 camels carrying water and other products such as bark of trees can be looked after by two of these young women.

The dry animals are kept in camps (fora) in more remote places, looked after by unmarried warriors. The "fora" herds are dispersed to distribute grazing and browsing, as well as security against a family losing all the herds in case of a raid. Camel herding (fora camels)as with other livestock, follows seasonal pastures and are moved from watering place to watering place. At times, camels and goats/sheep are herded together.

Forage eaten by camels fall into the following types (Field, 1979): trees and large shrubs of more than 1 m. tall, dwarf shrubs of less than 1 m. tall, herbs, vines and grass. But principally they feed on dwarf shrubs and to a lesser extent on trees and larger shrubs. Herbs, vines and grasses contribute less to camel diet, and mostly during or shortly after rain.

Camel Diseases

Before the work by Wilson and Olahu (1981), there were few systematic studies on camel diseases and their significance. The two researchers found a number of important diseases of camels, basing their work in four different areas in Kenya. While it was not possible to determine the economic effects of these diseases, trypanosomiasis, internal parasitism and mange were found to be of importance. Trypanosomiasis due to T. evansi (and T. brucei, T. congolense) brought about anaemia, abortion, loss of production and even mortality when acute - hence of great economic importance.

Of diseases caused by internal parasitism, haemonchosis was more frequently encountered. This leads to anaemia, as Haemonchus contortus sucks blood, as well as loss of production. Other internal parasites found were Trichostrongylus spp. and Oesophagostomum spp. Ticks found were mostly of the Hyalomma ssp., Rhipicephalus pulchellus and Amblyomma gemma. They use the camel as

a food source. Their presence especially in large numbers lead to irritation, anaemia, secondary infection, toxicosis as well as interfering with foraging and hence loss of production. Mange mites, also found cause irritation and loss of production.

Other diseases found were camel pox that causes camel-calf mortality of up to 50 percent, loss of production and bacterial diseases. Malnutrition, though uncertain, may play a role in all or some of these diseases in some areas. While therapeutic treatment is available to cure or alleviate most of the above diseases, a study on their economic effects on production would be appropriate.

Strategies for Increased Camel Productivity.

Camel population in Marsabit district is mainly amongst the Gabbra and to some extent the Rendille. While the latter have large numbers of cattle, whenever they have lost many of them due to drought, they have had to rely solely on camels to provide them with milk and blood.

While the various Integrated Project in Arid Lands (IPAL) studies have collected a lot of valuable data in about 30 per cent of Marsabit district, some of their conclusions are mis-placed. There has been too much singing of, "Pastoralism and Desert encroachment in Northern Kenya", when the role of pastoralism to soil degradation has not been quantified, apart from pockets in settled areas. It is possible that wind, rainfall and water may have over the years played a bigger role.

It ought to be realised that these people have witnessed the disappearance of pastures nearby and had to move to other places; watering places becoming dried-up, thus looking for water elsewhere; and their animals dying of drought often after they have tried everything within their means to save such animals by going to far places. Hence for development a combination of interventions is required. These are a bit of modification of their traditional systems of herding; provision of adequate water; and more and better security.

Any system that tends to ignore the traditional values and ways of herding will not succeed. The Food and Agricultural

Organisation (FAO, 1971) carried out a rangeland survey in Marsabit district and cane up with what they thought would be five viable units. They failed to realise that some of the blocks cut across traditional grazing areas. Furthermore they failed to appreciate the significance of dry and wet seasonal grazing areas. While what people want as a first priority is water, it is even more true that it should be available in more strategic locations. With the very strong winds available, there is no reason why wind power cannot be used to pump water 20-50 km. away. This would reduce the distance transport camels have to go. Secondly, more watering facilities would extend area available for foraging and eventually institute effective grazing control without disturbing the traditional herding patterns. This will also make it possible to have future settlements that would not lead to the degradation of the surroundings.

Once security and water issues are dealt with, it will be very possible to procure the peoples cooperation and their participation in further planning and implementation. From here, more appropriate marketing arrangements can be worked out. Currently there are no established markets for camels. Those who wish to sell their camels have to go the whole way to Wajir district. A camel sold for 3,000/- in Wajir s will fetch up to 5-6,000/= in Somalia and by the time it is being sold to Saudi Arabia, they are fetching KShs. 7-8,000/= each.

The potential for camel production has hardly been tapped and the nomadic pastoralists are left largely on their own. This potential if properly developed can make the camel contribute more significantly to the people of Northern Kenya as well as foreign exchange to the country.

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CAMEL PASTORALISM AMONGST THE RENDILLE*

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Introduction

The Rendille regard the camel as the most reliable of all animals. In drought periods, it is able to provide milk when the milk yields of other animals drop drastically. It provides blood and meat in larger quantities and its fat is considered to be highly edible. It is valued for its ability to do without water for long periods. This, and the fact that it is able to cover long distances without flagging, enables the camel to use pastures long distances from water. Their qualities as a pack beast are also highly regarded. Socially, the possession of large numbers of camels brings high status to the owner and the camel traditionally was the animal given in bride-wealth payments.

The camel is central in Rendille ideology and to become an accomplished camel herder is the goal par excellence of youth. Its importance is emphasized by ritual tabcos which surround actions relating to the camel. Only men who are at the time celibate are permitted to milk camels. The ideal herder is a celibate teenage youth. Failure to observe the milking prescription is believed to cause Camel calves to contract a disease known as sam. The majority of Sorio celebrations cannot take place if the camels are absent from the main camp. Sunday is regarded as the camel's day (Ahade Aseri Gall) because it was on that day that the Rendille first came to possess camels. Hence on Sundays camels are not brought to water, do not move camp, their milk must be consumed within the camp and they cannot be given to others as gifts or loans. If a camel gives birth on Sunday morning it must stay in its enclosure until the late afternoon and leaves are hung around the mother's and calf's necks (meydah). On Wednesdays and the fifth day of the new moon, pack camels may not be loaded. A breach of these prescriptions is thought to bring misfortune. In the past a man who killed an enemy was given a gift of a camel.

Household Livestock Holdings (i)

The following table gives some basic data on the stock holdings of households in town and country camps (2).

Table 1. Household Holdings of Livestock (3)

Animal Species	Location	Mean	S.D.
camel	town	12	13.3
	country	13	11.1
	total	12.5	12.3
cattle	town	8.3	13
	country	7.6	12
	total	7.9	12.5
sheep	town	84.5	82.1
	country	86.3	66
	total	85.4	74
goat	town	61.6	69.7
	country	79.4	59.1
	total	70.5	65

The overall average size of a camel herd is 12.5 head per household (s.d.:12.3). This confirms that the Rendille are a camel people. Given the fact that the average size of a household is 5.8, on average there are 2.2 camels per person. Country camps own statistically significantly larger herds than town camps. The widening gap between the camel holdings of poor and rich town households is indicated by the larger standard deviation which exists in the case of town camps.

The Rendille at present regard 1-10 head of camels as a small household herd, 11-39 head as a medium size herd and 40 or more head as a large herd. The Rendille are quick to note the overall drop in herd size in more recent years by pointing out that in the past large household herds contained 61-100 camels, medium size herds 25-60 head and small herds were those with 1-25 head. The drop in the overall size of household camel herds is due primarily to the fact that the human population has increased faster than the camel population.

In the past, Rendille households owned none or very few cattle. Investment in cattle over the last twenty to thirty years is due mainly to market considerations. While there are market facilities however inadequate, for cattle, the Government of Kenya has done little or nothing to develop a market for camels. The overall average size of a Rendille household cattle herd is 7.9 (s.d.:12.5). Town stock owners have statistically significant larger cattle herds than country owners. This may indicate that they are more oriented to the market than their country cousins.

The Rendille indeed own more camels than cattle. It is said, however, that the Ariall Rendille to the south have higher proportions of cattle.

Overall Rendille small stock flocks contain more sheep than goats: the average size of Rendille goat flock is 70.5 (s.d.: 65) and sheep flock is 85.4 (s.d.:74). The difference is smaller in the case of country camps. Country households on average own 86.3 sheep (s.d.:66) and 79.4 goats (s.d.:59.1) while town households have on average 84.5 sheep (s.d. 82.1) and 61.6 goats (s.d.:69.7). Indeed two of the country camps have higher proportions of goats to sheep.

The Rendille consider /_ mountainous and cold conditions to be more suitable for goats than for sheep. The plains where it is warmer and where there is less lava pavement are thought to be more suitable for sheep. This may explain why the Kargi stock owners have higher proportions of sheep in their flocks than their country cousins who reside on the higher slopes of Mt. Marsabit.

Acquiring Animals

The Rendille recognise different types of rights over animals. Where an individual is given an outright gift of an animal the practice is referred to as alal. The recipient in such cases has total ownership and use of the animal and of its progeny if it is a female.

There are two types of animal loans, namely maal and kalisime. In the former practice, the recipient has the right to use the animal until it is requested back by the owner. Male progeny belong to the recipient, while female progeny belong to the owner, but they may be left with the beneficiary as maal animals. In some instances, the

the maal animal may be left with the beneficiary until it dies. Spencer refers to the maal animal as a shared beast (Spencer 1973:37-40). The practice of Kalisime primarily gives the beneficiary the right to the milk of the loaned animals for a specified time.

While the alal practice transfers ownership of animals between households, maal and kalisime practices confer, immediately, on the beneficiary households rights of use of animals without change of ownership.

The analysis of livestock ownership underlines the fact that there is a wide range in the numbers of animals households own. Many households possess inadequate numbers of stock and thus the custom of loaning animals can tide such households over periods of scarcity. In general, transfer of ownership of animals only takes place between close kin, while animals are loaned not only to close kin, but also to neighbours and more distant kin.

Within households the male head is the legal owner of the household livestock. His wife has the right to the milk of his animals. Where the owner has more than one wife, he sees to it that each has a sufficient number of milch animals to meet the needs of their respective houses and this usually involves consultation with the senior wife.

The sons of the household slowly acquire rights in animals of their father or close patri - and matri - kin. Sons born after a difficult birth can receive a gift of a camel or a bovine. When the hair of the male infant is first cut (guthur) or when the male child has two teeth of the lower jaw removed (a practice which is dying out) are also occasions when sons obtain a camel or bovine. Circumcision and marriage are occasions par excellence, when sons obtain camels or cattle from their sisters' bridewealth livestock (gumo). Only junior sons obtain gifts of animals when their grandfathers (paternal and maternal), father and older brothers die.

The first born son inherits rights over all animals owned by his father. If he is still a minor when his father dies, his mother controls the herd under the supervision of her dead husband's brother (s) until he comes of age. In cases where the eldest is married and his father is senile, he, in practice, assumes the ownership of his father's herd before the latter's death.

In some instances, junior sons will be married and own at least their own separate small stock flocks at their father's death. The eldest son is obliged to find bridewealth stock for their younger unmarried brothers. The dependency of younger brothers on their oldest brother can lead to tension when the former feel that their senior brother has not their best interests at heart by failing to reward them with sufficient numbers of livestock in return for their labour in herding.

The natural path to animal wealth, particularly for men who begin life with few large stock, is first to build up small stock flocks and when these are sufficient in number, exchange them for larger stock. The exchange rates are as follows:

1 untrained pack camel:	12	small stock mixed in age and sex
1 trained pack camel :	13	" "
1 mature female camel:	30	" "
1 bovine heifer :	12	" "
1 bovine cow :	20	" "

This path to animal wealth also corresponds to the labour resources a household is likely to have. In the early stages of marriage a man will only have young children unable to take responsibility for adult animals at forr (4). It is best for him then to herd the small stock, even at forr. A number of married men herd forr small stock. If he possesses a number of camels, the appropriate strategy is to leave most of them in his senior brother's herd and take with him - if he decides to reside from his oldest brother-only milch camels. The most appropriate time for a stock owner to diversify his herd is when his chidren, particularly his sons, because teenagers because then he has the necessary household labour to herd all species of stock at forr.

Sons of very poor families can acquire stock by hiring their labour to more wealthy households. The going rate is one female camel or bovine per annum or twelve immature female small stock. However, n nowadays, poor men frequently look for a job and use savings from their wages to buy livestock to build up their herds.

Girls can also acquire livestock but in their case they only obtain gifts of small stock. For example at her father's death a girl receives a gift of a female sheep.

When marrying, a woman who is the first born of the household obtains a male camel (to be used as a pack animal) and a maal female camel. On the day that a newly married woman moves residence away from the camp of her own people she receives small stock presents particularly from her father and close maternal kin. These animals form part of her dowry (barito) and assist the couple towards establishing a viable household flock. When her own daughters marry, a gift of an immature female sheep (mintubis) is given to her and when the bridewealth is paid the mother also obtains one of the male camels to increase her number of pack camels.

Only women who have sons can look forward to widowhood with any comfort. The eldest son inherits the household's herd and is responsible for the welfare of his widowed mother. However a sonless widow who is young is left with her dead husband's livestock at least until it becomes clear that she will never give birth to a son. All livestock of a widow without a son except her barito stock can be taken from her by her dead husband's brother (s). Frequently women caught in such a plight come to depend on their married daughters.

Who Herds The Camels

The Rendille herd their camels, cattle and smallstock separately. In addition they frequently divide each species into main camp and satellite (forr) herding units. The table below indicates the age and sex of camel herders.

Table 2 Age/Sex of Camel Herders

Age	Male		Female	
Satellite Herding Units				
5- 9	2	(2%)	-	
10-14	17	(19%)	-	
15-19	28	(32%)	-	
20-24	15	(26%)	-	
25-29	18	(23%)	-	
30-34	11	(21%)	-	
35-39	-		-	
40-44	1	(1%)	-	
Local Herding Units				
5-9	3	(3%)	2	(3%)
10-14	10	(11%)	14	(21%)
15-19	3	(3%)	7	(8%)
20-24	-		-	
25-29	-		-	
30-34	-		-	
35-39	-		-	
40-44	-		-	
45-49	1	(2%)	-	
50-59	1	(2%)	-	

Herding of forr camels is mainly the work of youths and young men who are single. When camels are at main camps, they are divided into smaller herding units and these can be managed by young boys, girls and older men.

The Camel As a Subsistence Animal

Throughout most of the year, most of the camels are at satellite camps. During family festivals such as the major Sorio festivals, most camels are brought back to the main camps. Some milch animals are kept at the main camps if, and as long as the pastures surrounding the main camp are adequate. Camels at satellite camps are moved as much as 20 times in a year and can cover distances of 300-400 kms in these moves.

The following table illustrates basic statistics relating to the number of milch camels households own.

Table 3 Number of Milch Camels Per Household

	Mean	S.D.
Town Camps	2.7	3
Country Camps	3.0	3.2
Total	2.9	3.1

Since most of the camels are away most of the time, the forr herders gain most from the available camel milk and blood. Camel milk is never used to produce yoghurt or cheese.

Camels are slaughtered for meat mainly in drought periods. Those who wish to slaughter usually bring their animal to one of the slaughter-houses located in the trading centres. The animal is inspected for disease and, if cleared, is slaughtered for a fee. The owner keeps whatever meat he requires and the rest he sells. By slaughtering the camel and disposing of the meat in this fashion the owner avoids, to a certain extent, customary obligations of providing free meat to close kin and earns for himself cash income.

The Camel as a Transport Animal

The pack camel is needed to transport houses, household goods, very young kids and lambs, and young children and invalid adults when moving camp. The camel is also used to transport water for household use from waterpoint to camp. The following table gives information on the number of pack camels per household.

Table 4 Number of Pack Camels Per household

	Mean	S.D.
Town Camps	0.5	0.8
Country Camps	1.2	1.0
Total	0.8	0.9

Some argue that the lack of pack came.. have forced households to settle at one of the trading centres (Schwartz 1979). This is a half-truth and more applicable to pastoral groups such as the Gabra whose camps are small (i.e. averaging 4-5 houses per camp), highly mobile and are frequently located some distance from water. There are a number of Rendille households who decided to settle although they had at the time sufficient pack camels. Some of these later exchanged their pack camels for female animals. In these instances the decision to settle was not prompted by a lack of pack camels.

There are a number of households in country camps which possess no camels. Moving camp is done in stages and a person may not move all his loads in one trip. Those without pack camels may own donkeys or obtain a loan of baggage animals from within his/her own camp or from neighbouring camps. The fact that country camps do not move frequently and then only distances averaging between 4-10 kms facilittes those who own few or no pack animals. There is a similar sharing of pack animals for drawing water for household use. Where the distance between camp and waterpoint is not long those camel owners who own donkeys opt to use the latter.

The Political Economy of Rendille Pastoralism

Since camel pastoralism of the Rendille shares, more or less, a similar fate as their production of cattle and small stock in the wider economy and polity, the present discussion is generalised.

The day when the Rendille could directly depend on livestock production for their total livelihood has long past. The decline in the livestock/human population ratio first moved them to an indirect reliance on their stock. In other words, livestock were sold on the open market in order to purchase cereals. This shift in their economy took place in the 1940s. Nevertheless, they continued to rely totally (although indirectly) on livestock and its products. However, this indirect mode of reliance proved inadequate in the late 1960s and early 1970s when the livestock/human population ratio further declined. Supplementary sources of livelihood were sought in labour migration, cultivation, and the sale of milk and firewood particularly to the residents of Marsabit Town, the district headquarters.

The Rendille economy possesses all the major characteristics of a peasant economy: a heavy reliance on household labour in production; production for home consumption as well as for the market; variation in household livestock holdings and hence a variation in household wealth.

The Rendille economy, like all peasant economies, is not an isolated entity but is linked with a national economy and polity which dominates. Terms of trade between the livestock they sell and the products they purchase: cereals and clothes are unfavourable. Cattle

are sold to obtain large amounts of cash, small stock to meet minor expenses. The Rendille have no market for their camels. Hence camels can be bought for as little as 1200-1500 K. shs. Prices for camels in the North-Eastern Province are twice that because of the illegal trade across the Kenya/Somali border. However, these prices do not compare to the going rate for camels in Sudan (approximately $400 per head) where the main market is Egypt. Until the 1980s only ten camels were exported from Kenya through official channels. This increased between 1980-1982 to 180. These exports were to the Middle East.

Apart from the sale of livestock for cash, an important alternative source of income is wage employment. However the majority of Rendille job seekers are unschooled and hence obtain for the most part low-paid jobs.

It is unnecessary here to examine colonial policies towards pastoral groups in Northern Kenya. Between 1963-67, the new independent Kenya Government was preoccupied mainly with quelling guerilla activity in Northern Kenya. It could only concentrate on development activities after 1967 when the Dar-es-Salaam agreement brought the conflict to a formal end. Somali and Maasai pastoralists have benefitted to some extent from the First Livestock Development Project (1968-1973) and the Second Livestock Development Project (1974-1982). However, the main focus in these national projects was on ranching and cattle production. The development needs of the pastoral economy of the Rendille were not considered. Their only role in the national plan was to contribute immature cattle to the ranching community and even this operation was conducted on an irregular basis and sometimes even in an haphazard fashion (Njiru 1983). Little cognisance was taken of the fact that the Rendille kept mainly camels and small stock, animals which are most suited to their arid lands.

In conclusion, poor market facilites and low prices for livestock have stunted growth in the Rendille pastoral economy and prevented it from any take-off above subsistence level. As a result their economy is poorly monetised and little specialisation occurs. There are no inbuilt incentives to maximise production through investing extra labour in opening up new waterpoints and grazing sites, and in investing in veterinary services other than in a limited way.

Footnotes

* I wish to acknowledge my indebtedness to Messrs Peter Geikuku, Leiti Galborana, Augustine Nyayaba and John Rigano who acted as my field assistants amongst the Rendille. All are themselves Rendille and were employed as field assistants by the Integrated Project in Arid Lands Unesco.

1. The household is defined as the smallest domestic group which owns and manages its own independent small stock herd (cf. Dahl 1979: 70). Our concept of household differs with Dahl's concept. She defines it as "a residential local unit" (ibid.). We define it as an ownership unit irrespective of whether all its members reside together or not.

2. By a town camp, I refer to camps located at a trading centre. These usually remain permanently based at the trading centre although some households in the camp may move to the countryside occasionally. A country camp refers to those located in the countryside and these usually are mobile. The country camps we studied were located mainly on the slopes of Marsabit Mountain.

3. The reader should be warned that these statistics are representative of the Northern Rendille. They may be slightly modified as more data is acquired. This holds true for other statistics included in this paper.

4. Forr is the Rendille term for satellite camps which are located away from the main camps.

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CAMEL ACQUISITION AS THE MOST SPECTACULAR INNOVATION IN TURKANA MULTI-RESOURCE PASTORAL ECONOMY

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Introduction

African faces a major food crisis. Experts say that the situation is worst for the nomads due to recurrent droughts. There could be some truth in this; but one can also posit that droughts have always been there yet the nomads seemed to have coped well in pre-colonial times. The Turkana of the northwest Kenya, for instance, who are today poverty-stricken, and have to rely quite heavily on food aid, were in pre-colonial days a very prosperous people. The early European travellers and administrators described them as well-fed giants, wealthy and politically powerful. They were a conquering power due to their economic advances. (Odegi-Awuondo, 1983).

Origins of Turkana Prosperity:

The historical origins of the Turkana are still obscure due to lack of historical research into their past. What we have as the basis for reconstructing their past are fragmentary evidence.(1) Nonetheless, from available scattered evidence, it would be safe to suggest that the Turkana are an amalgam of disparate elements,(2) with a core that was indigenous to the land they occupy today. Historians argue that due perhaps to a series of environmental disasters in the Karamoja area where the ancesters of the Turkana lived, a series of dispersals began around A.D. 1500. One splinter group descended the escapment onto the Tarash river valley. Here this splinter came into contact with the previous occupants of the land. Intermarriage between the two led to increase in population resulting in further territorial expansion to the east, south and north. By c. 1700 A.D. expansion in these three directions from the

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1) See Professor William Ochieng's, An Outline of History of the Rift Valley of Kenya to AD. 1900, ch.4.

2) Professor Godfrey Muriuki in his book, History of the Kikuyu, 1500 - 1900, advances a similar thesis as to the historical origins of the Kikuyu.

Tarash cradleland must have begun. It was further stimulated by incursions of more migrants from the west flooding into the valley.

Interviews with elders during the author's fieldwork in 1981 among the Yapakuno elders recorded that the Turkana conquered eastern Turkanaland in living memory. They drove out the Samburu, Merille and Maasai from these territories. They stated that such place names as Kaleng, Lokitaung and Kakalai are of Samburu origin.(3)

It was in this era of expansion and conquest spearheaded by Turkana war chiefs that the camel was first acquired. It came from the east. Two theories have been advanced to explain the mode of its acquisition. One theory postulates that the diviners sent out warriors to the east to raid for the camel. The other theory holds that the camel was acquired peacefully through trade with the east: possibly from the Galla. Our knowledge of the history of the nomads compels us to accept both theories. Raiding was a way of life. But again the history of the Turkana reveals that they had developed strong trading links with their neighbours and in that case might have continued to acquire more camels. Yet the first ones must have been brought into Turkanaland through raids.

We have to re-emphasize, however, that when the Turkana began their outward expansion from the Tarash cradleland, they possessed only cattle, sheep and goats, and donkeys. They had no camels. This is again born out in their oral tradition.(4) There is no mention of the camel when they were still a proto-Turkana society in Tarash. Thus the camel is a recent innovation, in fact a very spectacular one. Why do I say "spectacular"? I shall illustrate.

The Camel acquisition as a Spectacular Innovation:

The acquisition of the camel was a landmark in Turkana economy. As I have argued elsewhere(5), it was a crucial factor which quickly revolutionised their pastoral production system. Its adoption became popular and widespread because they had struck a major discovery completely unknown in the part of the world where they lived. None of their neighbours to the west, north and south had camels. It was a rare species

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3) Interviews with the Yapakuno elders at Kaleng, November/December 1981.

4) See the story of Nayece and the Bull in Ocheing', op. cit.

5) C. Odegi-Awuondo, Human Response to Drought and Famine in Turkana Kenya, Ph D. thesis, University of Nairobi, 1983, ch. 3.

of domestic animal found only among the privileged easterners: the Boran, Gabbra, Samburu and Galla. They had never seen anything like this before.

They liked the camel basically for four major reasons. Firstly it was a species of cow which could feed on the vast thorny vegetation which hitherto remained unutilised and thus unprofitable. These could now be put to good use: thanks to the camel. Secondly, the Turkana discovered, to their immeasurable delight, that this strange animal was extremely resistant to diseases; few diseases attacked it, so it remained healthy much of the time. Thirdly, it could /withstand the worst drought and was watered only occasionally. It could therefore be deployed in a wide area thus allowing for even population distribution over the vast territories. And fourthly, and perhaps most important for them, was the fact that the camel was their idea of a hybrid cow, yielding many times more milk than the ordinary cow; /remained in milk much longer; and /could be milked several times in a day. In addition, camel milk was discovered to posses higher nutritional value than cow or goat milk. When they drank it they became strong and vigorous. Camel milk is rich in vitamin C and the polyunsaturated acids essential for human growth (FAO, 1982).(6)

It is under these circumstances that I say the acquisition of the camel helped to revolutionise the Turkana economy. From this strange discovery, the people were able to optimally utilize the land resources, produce more food, feed better, grow healthier, multiply more; and by the mid-19th century had emerged as a major power in the northwestern part of what is today Kenya. They were in control of a very wide area. They were a conquering power; and their expansionist ambitions were to pit them against the British intruders at the turn of the century, plunging the region into nearly two decades of resistance wars.

It would appear that as the camel crossed from the east into Turkana society, its role changed from being a beast of burden i.e. pack animal, to a precious dairy and beef "cattle". Unlike in other cultures, the camel in Turkana is surrounded with no mystique. It is a source of milk, meat hides and fibre. There are no cultural restrictions as to who look after the camel. Women, assisted by girls and boys, forage, water and drive the camel back home for milking.

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6) See also Nairobi Times, November 22, 1982 p. 11; Daily Nation, March 2, 1984 p. 12.

The Economy in the Inter-War Years:

The economic history of pastoralism in Kenya, and indeed East Africa, is a sad one to tell. It is one of impoverishment.(7) The Turkana case was even more chaotic than other areas. Between 1900-1919 the Turkana lost thousands of their livestock due to the punitive expeditions sent against them by the state. By the early 1920s the district was already povert-stricken. Hunger, disease and malnutrition became widespread and have persisted to the present.

Apart from losing large numbers of their stock at the hands of the troops, in the inter-war years (1919-1939) and beyond, taxation robbed the district of much of what remained of their property. Droughts, livestock diseases and raids from neighbours claimed yet another large portion. Thus the processes of capitalist exploitation led to a dramatic reversal of the fortunes of the pastoral societies. The Turkana who did not die from disease and starvation merely survived; their pre-colonial prosperity was no more. Thousands of the people became helpless destitutes. Only the well-to-do, those able to collaborate with the State, remained in possession of fairly large flocks and herds. The camel, for instance, became a status symbol. Even today wealth is determined to a very large extent by the ownership of camels. It is still as coveted as it was in the past. During one of my interviews, one respondent remarked: "The man is so rich, he owns 500 camels, and unknown number of cattle sheep and goats". He was referring to their MP who is also an Assistant Minister. The point here is that the camel is still an important domestic animal in Turkana peasant economy. It means a lot to own it or not own it. It is a hallmark of prosperity.

Conditions favouring Animal Husbandry in Turkanaland:

Turkana district is rich in natural resources which favour not only camel husbandry but a very viable pastoral economy as we have sketched above. Turkanaland has an area of 64,048 km^2, including some 2,000 km^2 of water (Lake Turkana). It occupies approximately one-ninth of Kenya's total land area, making it the second largest district after Marsabit. Its vastness in itself is a major economic asset to the people as it spans over four eco-climatic zones-III-VI.

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7) The process of pastoral impoverishment is discussed by R.M.A. Zwanenburg and Anne King, An Economic History of Kenya and Uganda, 1800-1970, ch. 5.

Much of the southern, western and northern parts of the district lie in eco-climatic zones III and IV. The land is higher here rising to about 2,000 - 3,000m above sea level, with their peaks in Loima, Karasuk, Loriu, Pelekech, Lokwanamur and Lorianatom Ranges. These areas receive higher rainfall which in certain parts may be as high as 700-1,000mm. per annum. They also enjcy a higher moisture index of -10 to -30 (zone III) and -30 to -40 (zone IV). Temperatures are cooler, never rising to 30°C even during the hottest days.(8) Large areas have rich volcanic soils suitable for crop agriculture. Much of this part is covered with evergreen forest formation and woody grasslands.

As one descends the escarpment towards the central plains, one enters eco-climatic zone V with an average elevation of 1,200m. It is hotter and drier than the higher grounds. The rainfall seldom exceeds 700mm per annum, and the moisture index is from -40 to -50. The temperatures are normally above 30°C. The forests give way to thorn bush comprising of Commiphora woodland with various types of Acacia, particularly Acacia tortilis, soft woods, several varieties of palatable browse and succulent grasses. This eco-climatic zone has pockets of sandy rich soils and sandy loams that are suitable for crop-based agriculture.

Zone VI covers the lowest parts of the district. These are vast plains stretching to Lake Turkana basin. The altitudes are between 400 - 900m., and the rainfall is low, ranging between 200 - 300 mm per annum with a moisture index of -50 to -60. The temperatures are extremely high recording mean annual maximum of 38 - 36°C. and mean annual minimum of 22 - 25°C. The combination of the high rate of evapotranspiration (total moisture loss from temperatures, evaporation and transpiration) experienced in this zone, leading to severe aridity. The predominant vegetation is thus annual grasses, dwarf shrubs, scattered stands of Acacia reficiens subsp. misera, and perennial grasses. The rest of the land is covered with barren sandy and rocky wastes. These extreme climatic conditions in the central plains, where Lodwar the district headquarters stands, set the trap for outsiders to dismiss the whole region as "a district of burning heat and sand wastes, harsh and uninviting by any standards".(9)

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8) Maralal in Samburu district experiences a climate typical of this eco-climatic zone: rainfall 986mm (max) 460mm (min) with a mean of 620mm per annum; air temperatures, maximum 23.6°C and minimum of 8.7°C. See D.J. Pratt and M.D. Gwynne, Rangeland Management and Ecology in East Africa, 1977 p.56.

9) James Barber, a former D.O. in Karamoja, is one good example of such outsiders. See his book: Imperial Frontier, p. 69.

The truth, however, is that Turkana is a land of contrasts thus offering wide scope for the pursuit of a diversity of economic activities, as indeed the people used to do in pre-colonial days. It enabled them to evolve and manage a very prosperous indigenous multi-resource pastoral economy. The landuse potential of the region is shown in the table below.

Turkana Land Use Potential.(10)

eco-climate zone	area in hectres (000)	Percentage	classification
III	74	1.2	agricultural
IV	613	9.4	semi-arid
V	3539	54.2	arid
VI	2308	35.2	semi-desert
	6534	100.0	

Sources: Government of Kenya: Arid and semi-arid Lands Development in Kenya. Framework for Implementation, 1980; Peter M. Ngau (1981:9); Turkana District Development Plan, 1979-83 p. 7.

The district is further blessed in having extensive water resources. Apart from Lake Turkana, the district has many large rivers, numerous springs, wells and abundant subsurface water. Some of the well known rivers are the Turkwell which rises from Mt. Elgon, runs through West Pokot into Turkana and empties its waters into the lake; the Kerio which starts just north of Eldama Ravine, cuts a dreadful valley through Elgeyo Marakwet and West Pokot and runs across southern Turkana onto the lake; the Suguta which flows from Baringo and enters the district underground and emerges as a series of hot water springs near Kapeddo, continuing north-eastwards into lake Logipi swamps; and the Tarash which rises from the Karasuk Ranges and runs northwards across the Lotikipi plains into the Ilemi Triangle. There are also several natural springs in the Ilemi Triangle, most of them fed underground from the Lokwanamur and Lorianatom Ranges. The hills and mountain ranges dotting the district are themselves a source of water. Furthermore, there are certain water sources

10) One endevour to examine the extent of the land use potential of the marginal lands, albeit briefly, is to be found in Peter M. Ngau. "Appraisal for Human Settlements and Infrastructural Resources of the Arid and Semi-Arid Areas of Kenya," Paper presented at the International Workshop on Strategies for Developing the Resources of the Arid and Semi-Arid Areas of Kenya," Nairobi 1981.

that remain secret; they are known only to locals. These are used during extreme droughts or times of severe water shortages. On the whole there is agreement among planners and scientists alike that water is not a major problem in Turkana, the district has more water resources than would have been expected in any arid environment.(11)

The greatest human resource which the district fortunately possesses in abundance is pastoral expertise. The Turkana are excellent and well-trained husbandmen. They have inherited efficient husbandry techniques which enable them to make the best use of the vast natural resources available in the district to raise large flocks of sheep, goats, quite an amount of cattle, camels and donkeys. In a good year, for example 1978, the land teems with millions of sheep and goats and thousands of the other stock species. Estimates put their 1978 livestock population at 522,895 cattle, 2,677,715 sheep and goats, 78,336 donkeys, and 112,383 camels.(12)

To the people, their land is well endowed with excellent pastures, adequate water resources, and suitable climate for the raising of livestock in a nomadic setting. Their culture, skill training, life-style and cognitions, are still centred on livestock. The people view with regret the forces that despise pastoralism and work to destroy it through the introduction of foreign values, norms and consumption patterns.

Pastoral Production Constraints:

Turkana economy is in a mess, not because the camel has been neglected, but because the entire pastoral economy has been the target of unpopular deleterious policies. The Turkana peasant producer has been left at the mercy of the vagaries of nature. Production has drastically declined over the decades. Poverty, periodic food shortages, famines, unemployment and malnutrition have become widespread. And as the case is with respect to all parts of the arid and semi-arid lands of Kenya, it has been fashionable to equate development with famine relief handouts or sedentarisation. The latter has been pursued at the total neglect and peril of pastoralism.

The vast natural and human resources in Turkanaland have not been tapped for development. Rather, the destitutes have been encouraged to

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11) See for instance Norad report on reforestation in the Turkana Area, 1979 p. 11.

12) These are KREMU estimates for the year 1978. See also Turkana District Development Plan, 1979/83, p. 17.

move out of pastoralism and settle down to plant along the banks of the Turkwell, or go fishing at the lake. Consequently, there has been population drift from the countryside to the banks of the Turkwell and to the lakeshore. The areas around Katilu Irrigation Scheme and Kalokol now experience heavy population concentration as pastoral drop-outs continue to migrate into them in the hope of finding some alternative sources of livelihood. The migrants exploit kinship, affinal or friendship ties in the process of migration and eventual settlement. There is heavy pressure on the land in these "urban" centres to the extent that they risk being turned into dust bowls.

Thus, for too long, only the waters of the Turkwell and the fish at the lake have been the focus of development. Little use has been made of the water resources in the mountains, hills, the plains and valleys; and not much use has been made of the extensive and excellent pasturelands in eco-climatic zones III and IV. The extensive soil potential, climate and mineral resources have similarly been left under-utilised. The same applies to the human resources, particularly the specialised husbandry expertise and management abilities of the Turkana nomads.

Prospects for developing the camel industry in Turkana

The cultural and material base for the development of a viable camel industry in Turkana does exist. However, the future will depend on whether or not the policy makers are ready to come to terms with objective reality and give pastoralism the attention it deserves. The present trend of impoverishment must be reversed and in its place one would like to see a sincere effort to boost livestock husbandry in the area.

But the task of developing a viable camel or pastoral economy within the existing capitalist framework is not an easy one. A purely export oriented development with weak backward linkages with the other sectors of the local economy will never benefit the people. This has been the trend in Turkana since the 1960s; a development model which is extremely deleterious. The question we must ask is: Development for who? If it is not development for the people, then it is not worth discussing. Planning scarcity, in my view, can never be an honourable thing.

Research Needs:

To aid in the development of camel pastoralism in Kenya in general and Turkana in particular, social scientists will have to address themselves to a number of issues including:

(i) The interrelationship between the camel and the other domestic animals.

(ii) The isolation of key variables determining camel production.

(iii) Consumption demands: local, national and international.

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THE INTRODUCTION OF CAMELS INTO A LOWLAND SAMBURU AREA

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Summary

This paper describes the introduction of camels among a group of semi-nomadic cattle herders. It shows that while the Samburu of northern Kenya have had a long and close association with many of their camel-keeping neighbors, only recently have they adopted camels for use in their own encampments. This introduction seems to be related to a twenty-five year decline in their cattle economy. Since 1960, four droughts, raiding, and several epizootics have more than halved their aggregate cattle holdings. Simultaneously, Samburu grazing areas have been cut effectively by one third, while the population has increased by some fifty per cent.

The paper examines the extent of camel holdings and attributes of the new owner. Samburu camel holdings are still dwarfed by cattle properties, but the number of camel owners is steadily growing. Those adopting camels are among the more progressive and wealthy cattle herdowners. For most Samburu, camels are expensive, hard to maintain, and difficult to manage.

The paper finally considers the rationale for and implications of camel-keeping in Samburu. The camel is being primarily adopted to provide milk during the dry season. Its proven ability to withstand drought, however, is being increasingly valued. Ironically, keeping camels gives the herdowner greater leeway in managing his cows and, for now, the two are seen as complementary resources. By adopting camels, Samburu pastoralists are trying to diversify their interests as security against an uncertain future.

Introduction

The Samburu are a group of semi-nomadic pastoralists living in north-central Kenya (in "Samburu District"). They are Maasai-speakers and probably number some 66,000 people (GOK 1984). They have traditionally tended cattle, sheep, goats and donkeys and continue to live primarily off the products of their herds. Agriculture, fishing and hunting are negligible activities and these herders still pay for commodities by either selling live animals or animal products (e.g. skins, hides, milk).

Until recently, the Samburu were considered as one of the more specialized and one of the more successful cattle-keepers in East Africa. They had been an important supplier of immature animals to the Kenyan market (Perlov 1981) and researchers had variously assessed the cattle to people ratio at 17.5:1 to 8:1 (Schneider 1979, Spencer 1965).[1] Within the last twenty-five years, however, the Samburu have experienced a series of crises which have depleted the cattle herds of all and left many elders completely stockless.[2] Wide-spread raiding of 1964 - 1980 resulted in losses of men and livestock. And animal diseases: Foot and Mouth 1970, 1976 and East Coast Fever (starting 1976) have specifically swept through cattle herds.[3] But the major disasters have occurred in the form of drought. In the past twenty-five years, the Samburu have sufferred through four extensive dry periods, 1959-61, 1965, 1971, 1979-80; they are presently trying to survive the fifth. In the 1980 drought, the severest - so far, government reports assess that fifty per cent of the cattle herds were lost in the lowland area of Wamba Division alone.

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[1] According to Schneider's assessments (1979), the Samburu cattle to people ratio is surpassed only by that of the Barabaig of central Tanzania; theirs has been figured at 18:1. While such quantitative data is usually guesswork, the researcher hopes that Schneider's figures represent gross trends. That is, the Samburu were relatively well-off compared to other groups surveyed.

[2] A recent Samburu District Development Plan estimated that 50% of the population should be candidates for famine relief, with 10% being virtually destitute (GOK 1980).

[3] There are no official estimates of the magnitude of these losses. Perlov (1982) mentions a prominent trader in Maralal who suspects that East Coast Fever along reduced the Samburu cattle herds by 60%.

Recently, the acquisition of camels by Samburu elders has attracted some interest (Stiles 1983 a,b,c). While the Samburu seem to be adopting camels, the reasons for the introduction and the role camels play in their cattle economy remain unclear. This paper aims to outline varied aspects of this novel development and to provide information necessary to evaluate its importance. It first considers the relationship of Samburu herders to camel-keeping peoples, and reconstructs the history of camels actually managed by Samburu elders. It then describes several facets of the current phenomenon; What are its quantitative parameters? Who owns camels? What might be the concerns of the new camel owner? The paper closes by suggesting some of the ramifications of camel keeping ---for the Samburu, their land, and their cows.

The Setting

Samburu District is located in north-central Kenya, at the southern end of Lake Turkana. It is an administrative entity of 20,809 sq. km., and approximately 95% of the Samburu population have base encampments within its boundaries.

The District is characteristic of many of the areas used by pastoralists. Lands are arid and semi-arid; and dwarf shrub, bushed and wooded grassland stand as the prominent vegetation. Soils are generally very poor; most are volcanic, ranging from clays to sandy loams. Rainfall is erratic, highly localized and unpredictable from year to year. In limited mountain areas (up to 2750 m) and highland regions, forests, evergreen bushland and grassland provide pockets of potentially more productive land. However, most of the District, 84% of the land, has been classified as "low potential" (GOK 1984).

The divisions of the District (Lorroki, Baragoi, and Wamba) are sufficiently distinct to warrant comment. Lorroki, in the south east, encompasses the highland plateau, Kirisia grasslands, and an extensive forest reserve. It has one long, reliable rainy season which peaks in July and August (vs. a bimodal rainfall in the other two divisions). It is only here that group ranching and agricultural experiments have been initiated. The division is bounded on the west by a

rugged escarpment which effectively isolates it, and on the south by the ranching areas of Laikipia.

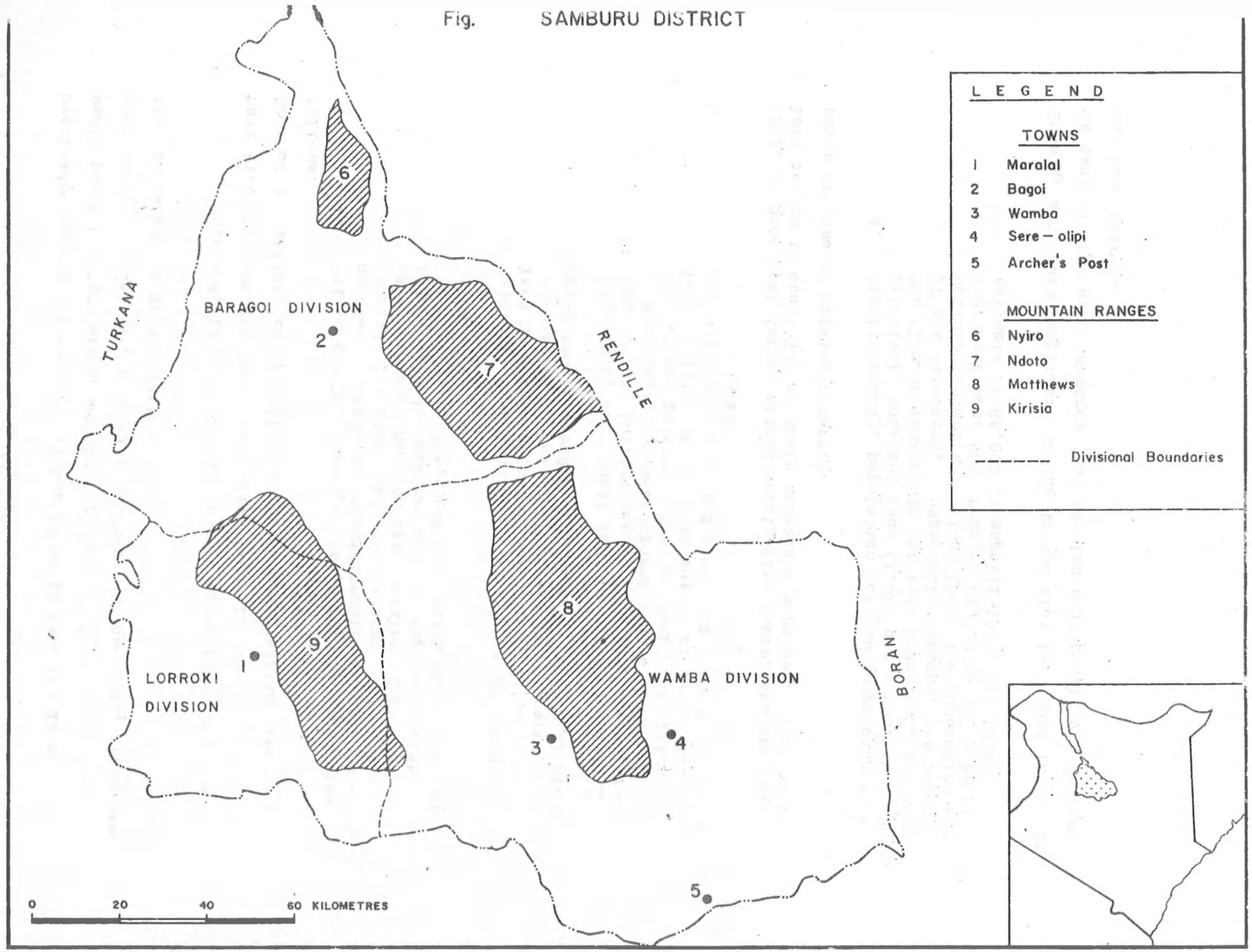
Baragoi, in contrast, is primarily a division of lowland plains; its thickly forested Nyiro and Ndoto ranges a stand as oases in a rocky desert. This division receives the least rainfall; the yearly average hovers between 300 and 350 mm. Most of the District's 14,000Turkana live here, and the blending of Samburu and Turkana culture marks one of Baragoi's more distinctive features. Baragoi was plagued by ngoroko raids of the 1970s and still receives those fleeing from attackers.

Wamba is both the largest division and the host of the largest herds. Cut by the Matthew Range, Wamba's western basin contains the heart of Samburu lowlands; its eastern plains (less than 1000 m) are now used as dry season reserves. Rendille, not Turkana provide the dominant foreign influence in the division. The eastern plains are shared by both Samburu and Rendille herders and the Rendille towns of Merille and Laisamis provide foodstuffs for Samburu in outlying grazing camps. Wamba, like Baragoi, has an insecure border. Shifta raids of the 1960s depleted cattle herds and pushed Samburu homesteads west over the mountains.

Wamba Division proves to be an appropriate area for examining this new phenomenon of camels and Samburu. Lorroki, with relatively high rainfall, grass and cooler temperatures, poorly supports camel herding. Baragoi, hot and dry, blesses camels, and has for many many years --- Turkana camels. Wamba Division, in contrast, always has been cattle country; cattle, sheep and goats. And until recently, Wamba sported extensive savannah rangeland. It has been suggested that the introduction of camels is a response to a gradual deterioration in Samburu rangelands (Stiles 1983 a,b,c). This section closes with some brief comments on current and past Samburu land use.

Much of Samburu District presently is overgrazed. Large areas of central lowland are grassless and deeply gullied --- and apparently were not so in the recent past. Ecologists working in Wamba Division assess that the area is 60% overstocked that is,

Fig. SAMBURU DISTRICT



LEGEND

TOWNS

1 Maralal
2 Bagoi
3 Wamba
4 Sere – olipi
5 Archer's Post

MOUNTAIN RANGES

6 Nyiro
7 Ndoto
8 Matthews
9 Kirisia

------ Divisional Boundaries

overloaded beyond the capacity of the range to feed cattle and small stock and regenerate pasture (G.E.S.P. 1980). Few would deny that there has been a secular, rather than seasonal, deterioration in rangeland productivity.

Such a decline should not be surprising for those who have lived through the last twenty-five years in Samburu land. Some of the factors contributing to the land degradation are as follows:

1. Within the last twenty-five years, the boundaries of Samburu have been significantly reduced. Due to security problems, most of the area east of the Matthews Range has not been settled since the mid 1960s; And the western edge of Baragoi Division has been neither settled nor grazed since the early 1970s.

2. Within these bounds, much of the higher potential land has been usurped for more restricted users. These areas include the Samburu Game Reserve, the group ranches, and the highland agricultural plots.

3. Circa 1976, East Coast Fever swept through cattle herds of the Lorroki highlands. To prevent spread of disease, the lowland pastoralists no longer use much of the plateau. They not only lose grazing land, but the grass of an entire rainy season. i.e. The showers of July and August are usually confined to the highlands.

Thus, in practical terms, within twenty-five years, Samburu have lost access to about 30% of their rangeland expanses, much of it prime dry season grazing reserves.

4. Simultaneously, population has been expanding at a relatively constant pace (1.02% per annum. GOK 1984). The flow of immigrants has been unchecked, and many of the newcomers, especially Turkana, are pastoralists themselves. Since 1960, the population has increased some 50% from c. 43,000 to the current estimate of 66,000 (Fumagalii 1977, GOK 1984).

In sum, many more people are trying to use alot less good land. It is against this grim backdrop that the issue of camels and Samburu has been raised.

Relation of Camels to the Samburu

Camels have never been very far from Samburu. The District itself is mostly bordered by people who keep camels: Boran on the south and east; Rendille on the north and east; Turkana on the northwest; and Somali traders used to lead camel caravans through Samburu. In addition, the obvious mobility of herders suggests that Samburu and camel keepers frequently live side by side. Such inter-tribal relations are not always amiable. Periodically, for at least seventy years, Rendille, Turkana, and even Gabra have been expelled from official Samburu territory (see Sobania 1979).

It is the Samburu/Rendille relationship which has been most thoroughly described by anthropologists. Paul Spencer (1973) suggests that years of intermarriage and intermigration have created strong ties of kinship as well as a firm political bond between the two tribes. In fact, he sees the fastgrowing cattle economy of Samburu as a receiving basin for Rendille fleeing from the relatively stagnant camel economy. The closeness of Samburu/Rendille ties can be demonstrated on many counts. 1) Several Samburu sections, clans, and lineages have corresponding social units in Rendille. 2) Rendille women frequently marry Samburu men. 3) Rendille and Samburu have formed stock friendships for many many years. 4) At various times through history, poorer Rendille have come to herd Samburu animals and similarly, Samburu have gone to Rendille land. 5) Finally, many Samburu speak of their camels being herded at Marsabit (in Rendille land), and Rendille mention lending their cattle out to Samburu relatives. While all of these relationships have potentially involved the transfer of animals to Samburu homelands, in practice, few camels seem to have moved west. Samburu claim that when camels are given in stock exchanges or as gifts, the Rendille part only with the male animals (or substitute goats as often as possible). Further, Samburu have had great difficulty claiming back what are "their" camels one the stock has been farmed out to Rendille lands. Ironically, it is more often Samburu who give camels to Rendille. Young Samburu men must buy camels to pay bridewealth to their Rendille in-laws.[4]

[4] The above material has been substantiated from a variety of sources. See Sobania 1979, Spencer 1965, 1973.

The closeness of Turkana and Samburu relations has received less attention. In general cultural lore, the two are seen as enemies, having a century-long history of raiding each other's stock. Further, the Samburu circumcize their men and women, an event which remains central to achieving adult status. That the Turkana circumcize neither sex affirms, in Samburu code, the former's puerility, wildness, and almost sub-human status. The Turkana's liberal food habits (e.g. they even eat fish!) and position as menial laborers in many Samburu towns, serve to widen the cultural in compatibility of the two groups.

In practice, however, Samburu and Turkana share a series of close relationships. 1) Intermarriage is common. Samburu men frequently marry Turkana women and a few Samburu women are sent to Turkana. 2) Many Turkana live within Samburu District. The latest census estimates that 17% of the District population is Turkana, making them the largest non-Samburu ethnic group. 3) Historically, Turkana and Samburu have served each other as wage laborers. However, while Turkana continue to be hired, the hiring of Samburu was limited to a short period in the 1890s, during outbreaks of rinderpest and smallpox. 4) Some Samburu families have similar named lineages in Turkana. As in the case of wage laborers, these are the families who moved northwest during the 1890's crises.

This review of the relationship of the Samburu with select camel-keepers has shown that this "cattle people" has had a long and varied association with camels. They have directly owned them and lent them out; they have married into families with camels; some have even helped pasture camels, e.g. when hired as wage workers. In some ways, however, camels have been foreign to Samburu. Historically, there have been few camels grazed within Samburu territory (presently equated with Samburu District).

The Introduction of Camels to Samburu District

Camels seem to have been introduced in Samburu District in the early 1920s. Families obtained one or two (by bartering goats for Rendille camels) and used the animals for transport. Most were male, although a few elders recall their mothers milking

the stock. Not everyone had a camel; one might have seen a single beast in a survey of five to ten encampments. A 1928 census in the highland area of Lorroki plateau suggests how scarce camels were; administrators tallied 189 camels (all pack animals) in contrast to a cattle population of 62,314 (Sobania 1979). Camels may have been more numerous in the more arid and hotter lowland areas.

There are few significant events concerning Samburu camels until the early-mid 1950s. Samburu stress that the period 1930-1955 was one of unparalleled cattle population growth. An invasion of locusts in 1943, and a small drought in 1944 were among the very few checks on this boom economy. Demographic statistics demonstrate just how expansive holdings were. Although the human population tripled in the twenty-two year period 1933 - 55 (from 12,000 to 36,000; an increase of 200%), the cattle population was able to match the pace (from 119,408 to 350,000; an increase of 193%) (Fumagalli 1977). Elders comment: "When there are cattle around, we have no need of camels". Those who did have camels most often loaned them out to Rendille stock friends.

Spanning this same period (c. 1920-55), however, there were camels in lowland Samburu --- subsistence camels owned and managed by the Turkana. The story of the Turkana "infiltration" is a complicated one. In brief, from 1915 onwards, a steady stream of Turkana flowed through Samburu District. Entering through Baragoi, the Turkana first moved along the District's northern fringe, toward Rendille land, and later cut centrally across, straight to Isiolo.[5,6]

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[5]The routes have been reconstructed as follows:

a) the northern route: via Baragoi, Lonanikin, Sikira, Lkajaj and Suiyan to Rendille land.

b) the central route: via Baragoi, Barsaloi, Swari, Nkaroni, Nagoroworu, Archer's Post to Isiolo.

[6]See Sobania, 1979: 133 ff. for detailed historical account of Turkana movements within several northern Kenyan Districts. See also Hjort 1981 for analysis of Turkana economic and social integration with the Samburu in the Isiolo area.

The Turkana who came were of two types. In the first instance, many were completely stockless, wiped out by British punitive expeditions of 1915 - 18. Individually, or as complete households, they sought work as hired herders. Many were faithful and hardworking, and in return for their services were paid in livestock. Numerous Turkana eventually re-established separate, herdowning households. Sometimes Turkana adopted the employer's name, were circumcized, and remained in Samburu. In the second instance, the Turkana pushed into Samburu rangelands due to insufficient grazing in their own homeland. Whole encampments first crossed into Baragoi (1915-25) and quickly fanned out west and south. By 1931, there were Turkana on Lorroki; by 1934 as far east as Seiyo (Sobania 1979).

Both of these trends resulted in the import of a limited number of camels to Samburu. Once Turkana hired workers established themselves, they called their relatives back home to join them --- with their few camels. And those setting up permanent encampments, though poor, often trekked in one or two camels. In the mid 1950s, Turkana were chased from Samburu District purportedly because the had "overpowered Samburu". They left, however, a twenty-year legacy of camel rearing within Samburu.

It was at the turn of the 1960s that Samburu themselves slowly started adopting camels.[7] A series of closely-spaced droughts, in 1959-61 and 1965, convinced several progressive cattle-owners to invest in one or two camel heifers. The camel's milk-producing qualities were of paramount interest; camel udders are full when those of cows are dry. While these investors first sought to recall loans from Rendille friends, few were successful. In isolated cases, a male calf or bull camel was returned, but most eventually purchased animals from Turkana at Baragoi.

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[7] In the 1950s, a few herdowners, either Rendille or those married to Rendille women, brought their camel herds to the Samburu lowlands. They remain among the wealthier owners in the region and serve as camel consultants to the less knowledgeable Samburu. They came, however, for diverse personal reasons and their arrival did not herald a trend.

The raids of 1964 - 1968 provided the second catalyst for buying camels. The Samburu not only lost many animals, but a large part of their homesteading territory as well. As all land east of Sere-olipi was no longer secure, the Samburu were relatively crowded within the lowland basin west of the Matthews Range. It was at this time that the Samburu first recall having to send all their cattle, even milking cows, to dry season pasture for extended periods. Camels were again purchased, in limited number, to supply children with milk during the dry season.

The 1971 drought or "The Terrible Hunger" proved to be somewhat of a watershed in the history of camels and Samburu. It was a devastating drought, and at the tail end of other formidable disasters. Interest in camels grew, as did their accessibility. Turkana profferred a regular supply of heifers at their Baragoi markets; in addition, Somali traders brought camels through Samburu from two separate directions. Along the northern route, the Somali purportedly sold camels brought from their homelands. Along the central route, they traded Turkana camels.

The 1979 drought merely reinforced the Samburu suspicions; the life of a cattle pastoralist was no longer a secure one. In efforts to diversify their interests, elders systematically started to send one or two of their children to school, and warriors, en masse, sought wage employ. It is also since that time that the verbal commitment to adopt camels has become widespread; action has been limited. Presently, probably because of the failure of two successive rainy seasons, young elders regularly discuss the pros and cons of purchasing camels.

In summary, between 1960 and the present, the Samburu have sufferred a series of disasters which have severely cut their cattle holdings. Detailed herd histories of some 51 elders assess average losses, just in 1980, at 50 - 60%. The official Samburu District figures suggest a formidable decline in cattle holdings over a longer period.

Table 1 presents statistics on both Samburu human and cattle populations for the period 1933 - 1983. The figures are drawn from official censuses and varied reports of colonial administrators. Their authenticity is doubtful.

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Table 1. Human Cattle Population [8,9]

Samburu District 1933 - 1983

YEAR	HUMAN POPULATION Samburu	Others	Total	CATTLE POPULATION	HEAD OF CATTLE PER PERSON
1933	12,000 e			119,403 c	10
1948	18,797 c				
1955	36,000 e			350,000 e	9.7
1962	43,000 e	13,935 e	56,539 c		
1969	51,503 c	18,016 c	69,519 c	420,000 e	8.2
1977				241,120 c	
1978				221,205 c	
1980/81				127,260 -55%	
1982/83				109,094 c	
1983	65,697 e			158,674 c	2.4

c = census material e = estimates

Certainly, the figures suggest a dramatic, long-term decrease in Samburu cattle holdings. Whether the cattle to people ratio has dropped from 10:1 (1933) to 2.4:1 (1983) cannot be verified. In all cases, however, elders concur that their losses have been great.

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[8] To list a few of the many possible sources of error in the census material.

human population census

1. Censuses are made at base encampments. Many of the Samburu, however, tend herds elsewhere and Samburu rarely volunteer information on those not present.
2. Samburu believe it unlucky to state the exact number of offspring. Further, all Samburu are prohibited from saying the names of large categories of people. e.g. A warrior will never say the name of a fellow warrior.

cattle census

1. The animal censuses of 1977-1983 represent the counts of cattle brought to vaccination crushes. All the campaigns pre-1983, however, were prematurely halted due to vehicle and fuel shortages.
2. Herders do not always bring their cattle to be vaccinated. Many elders see a direct link between vaccination of cattle and a) increase in disease and b) decrease in milk output. In addition, the vaccination campaigns sometimes occur when animals are at far,-removed grazing camps.

[9] For sources of the material in Table 1:
Figures for 1969 and before were taken from Fumagalli 1977:338. He lists his sources as follows:
D/C/SAM/3/1: proposal to remove the Samburu from the Leroghi Plateau. Isiolo, Oct. 15, 1929.
DC/SAM/1/3: Samburu District Annual Reports 1948, 1955.
PUB.24/3/1 : Samburu District Annual Report 1969, 1970.
for 1977 - 1983. See GOK 1984: 4,8,42.

Camels and Samburu Owners: A Quantitative Sketch

The extent of this camel phenomenon is hard to assess. Camel counts are as difficult to obtain as cattle counts. Further, many of the camel owners within the District are Turkana grazing in the same northwest area they have been using for over half a century.

Samburu District officers completed the most recent livestock census in January 1984. In the course of a Foot and Mouth Vaccination Campaign, officials counted the number of cattle brought to the crushes, and queried herdowners about their other holdings: sheep, goats, donkeys and camels. The government tallies on cattle and camels are presented in Table 2.

Table 2: Livestock Census - Samburu District 1983

Division	Cattle	Camels
Baragoi	35,795	6,863
Lorroki	54,171	749
Wamba	68,708	2,670
Total	158,674	10,282

These figures are useful in representing several current trends. First, the number of camels pales next to the number of cattle. Second, the distribution of camels is markedly uneven, two-thirds of the camels being in Baragoi. Such a concentration is predictable as this division contains some of the driest areas in the District and hosts the majority of the immigrant Turkana camel keepers. What is surprising is that there are any camels in the higher potential Lorroki area and that Wamba Division, particularly the area west of the Matthews, contains some 2000. camels.

In terms of absolute numbers, however, the figures may be misleading in describing the total cattle and camel holdings of Samburu pastoralists.

A. Cattle Numbers

Only 1512 herdowners (out of a potential 7730) brought animals to be vaccinated. Some elders may have brought the holdings of several men. This is suggested by the very high average holding of 105 cattle per elder and by comparing individual entries on the tally sheet with my own fieldwork census.[10]

However, many elders did not bring (or send) their animals to the crushes. Government officials estimate they tallied 60-70% of the herds. The campaign was scheduled to coincide with the November rains, a time when animals are kept nearby home settlements. The rains failed, however, and many animals were off at distant grazing camps. Several chiefs suggest that the proportion of uncounted herds in their own sub-locations may be even greater --- over 50%. They say elders are wary of innoculations.

B. Camels were not counted. Herdowners were simply asked to state their camel holdings when they brought their cattle to be vaccinated. The census may misrepresent Samburu camel holdings on several counts. First, there are some questionable entries. If a Samburu herdowner wants to wildly exaggerate how many camels he has, the elder may say 100. Three of those queried in the census claimed they owned 600, 100, and 2000 camels respectively. Second, many of the herdowners listed in the Baragoi census were Turkana. In fact, about 60% of the camel holdings in the Baragoi counts belonged to Turkana elders (4278 out of 6863). When the overinflated estimates and Turkana holdings are eliminated (both cattle and camel numbers), the livestock census for 1983 is revised as follows:

Table 3. Revised Livestock Census - Samburu District 1983

Division	Cattle	Camels
Baragoi	28,636	2585
Lorroki	54,171	749
Wamba	68,542	2070
Total	151,349	5404

[10] Two others have assessed the average holdings per Samburu elder at between 30 and 50 cattle (Field, personal communication; Perlov 1982).

As the tally stands, cattle holdings outnumber camel by 28:1. From actual observation, I would more likely assess the holdings at 60:1. There are many, many encampments with not even a single camel.

My own work has been among the camel keepers of Wamba Division, west of the Matthews Range. I have interviewed 30 camel owners and compiled reliable statistics on 66. I estimate this smaller sample encompasses 30 -40% of those who own camels in the lowland area.

What can one say about these camel owners? Their holdings range from a single camel to a herd of 72. Mean camel herd size is 14; the mode is 8. While those with holdings greater than 15 head have generally tended camels for fifteen to twenty-five years, the majority are relatively new to this form of pastoralism, that is veterans of the mid - 1970s buying spree.

Perhaps most important, with the exception of two Rendille elders and a Samburu chief, this sample has been identified primarily as cattle men. All are wealthy, as assessed by others.[11] They also encompass a surprising number of modern herdowners. Many dabble in small-scale livestock trading, hold local administrative posts, or, at some point in their careers, have held salaried positions outside the encampments. While several have strong ties to camelkeeping peoples, most identify themselves as traditional Samburu. All eight Samburu sections are represented in the sample. In brief, these 66 camel owners are drawn from the pool of progressive, wealthy, Samburu pastoralists. Their cattle holdings are secure. They have bought camels to diversify their interests and perhaps to prepare for an uncertain future.

Problems of the New Camel Owner

There is nothing easy or natural about a cattle pastoralists adopting camels. Herdowners starting to build up herds

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[11] While I have complete livestock profiles on a dozen of these elders, I have no reliable counts on the cattle and goat holdings of the majority. A wealthy herdowner would have seventy cattle and above. A few still own six to seven hundred cattle. Small stock holdings might run to several thousand.

recount three central problems. They have difficulty obtaining camels, labor problems in pasturing them, and no experience either in preventing disease or treating sick animals. The following discussion will focus on their first two concerns.

A. Obtaining Camels

Samburu elders classify the different breeds by the tribes who use them. Hence they describe the various as Somali, Boran, Rendille and Turkana. The variables herders consider of prime importance include a) the quantity of milk production b) the quantity of meat c) the size of the fat hump and d) the rate at which the camel reproduces, including the total number of reproductive years. While all acknowledge that the Somali camel is the biggest, and the best milk, meat and fat producer, elders disagree as to its relative rate of reproduction, and its ability to survive in Samburu land (i.e. "not hot enough", "not enough leaves"). On the comparative merits of the other breeds, however, herdowners show little consensus. The Turkana may be the smallest, but such a detraction is offset by its unusual ability to resist drought. Further, many potential buyers are unclear about whether the Boran and Rendille are of different stock at all. The animals of the northern pastoralists may be as interbred as the tribal groups themselves; and certainly, most of the Samburu have never had a chance to compare what may be four more or less distinct camel varieties. In any case, the Somali camel commands too steep a price for most Samburu herders and of the other three--the Samburu take what they can get.

Herdowners have three potential choices for camel markets. They may travel east to Marsabit District (Rendille) or south to Isiolo District (Boran). However, most buyers head northwest to where Turkana sell camels, in Samburu District itself (Baragoi). Occasionally, they also buy Turkana camels, from Somali traders who lead them through Samburu District. At Marsabit, Rendille rarely sell the female camels; and at Isiolo, the Boran and Somali demand high prices and often insist on being paid in stock-- either oxen or goats. The Turkana, in contrast, prove to be willing and relatively cheap sellers. Baragoi is a convenient market center

for many Samburu elders and certainly within the realm of possibility for most. The trek from Wamba town to Baragoi town would take a capable walker two to three days.

For those interested in camels, Samburu elders regard high prices as the greatest obstacle to their buying more. Roughly, a camel is twice as expensive as a comparable cow (that is, comparable in terms of age, sex and health). Samburu often cite the wet season prices of camels to indicate how exhorbitant they are. Buyers, however, usually obtain camels in the dry season; prices are lower and more animals are available for sale.

The following are the approximate 1984 prices for young camels and cows at Baragoi. The older, non-pregnant heifers (ntawo kitok nemeiturukum) and those pregnant for the first time (ntawo naiturukum) are the animals most in demand.

Table 4. Livestock Prices at Baragoi - Samburu District 1984

WET SEASON	Turkana Camels	Cows
older heifer	1500-1800	600-800
pregnant heifer	1800-2200	750-900
DRY SEASON		
older heifer	1100-1300	400-500
pregnant heifer	1300-1500	500-600

prices in shillings. Ksh. 13.5= $US 1.00

There are times, however, when Samburu obtain camels by trading one type of livestock for another. Rates for Turkana selling Turkana camels and Somali selling Somali camels are estimated in Table 5. Prices only partially depend on the attributes of the animals. The skill of each negotiator and the immediate need of the seller are equally important.

Table 5. Livestock Exchange Rates at Baragoi - Samburu District 1984

	TURKANA CAMELS goat rate	cattle rate	SOMALI CAMELS goat rate	cattle rate	COWS
WET SEASON					
older heifer	20-25*	1 big ox + 1 male calf	20-25**	1 big ox + 4 male goats	15 goats
preg. heifer	25-35	2 big ox	25-35	1 big ox + 7 male goats	
DRY SEASON					
older heifer	15-20	1medium ox	15-20	1 medium ox+ 1 male calf	12 goats
preg. heifer	20-30	1 very big ox	20-35	2 small oxen	

* Turkana trade mostly for female goats
** Somali trade only for male goats

The exchange rates for the Turkana and Somali camels are not at all comparable. Although a Turkana heifer camel might sell for 17 goats and a Somali heifer camel for the same number, the type of goats is different. The Turkana desires mostly female goats (Sipeni); he is interested in herd reproduction. The Somali will only take male goats (castrated and uncastrated, loroi and lkinoji); he buys to sell them again for meat. The price difference might translate into shillings as follows:

DRY SEASON

Turkana Older Camel Heifer

12 female goats @ 70 Ksh.	= 840
3 uncastrated male goats @ 100Ksh.=	300
2 castrated male goats @ 130	260
17 goats	1,400 Kshs.

Somali Older Camel Heifer

7 uncastrated male goats @ 100 Ksh=	700
10 castrated male goats @ 130Kshs. =1,300	
17 goats	2,000 Kshs.

Camels are expensive. For those who know little about them, the move to purchase a "two cow or seventeen goat" experiment is a risky one.

B. Management

From the time of his birth, a Samburu is taught to think about, act with, and love cattle, sheep and goats. He has years to learn about his charges; he can tap into a legacy of herding legend and technical expertise; and he is directly guided by those who know. The new camel owner, in contrast, is principally alone. Many of his concerns stem from not knowing his choices.

In terms of management, the most fundamental problem is to overcome the fear of the animal itself. While the elder usually has rationalized his purchase and has a superficial idea of how to keep it, those who actually work with the animal are less consenting participants. Women have to milk the large, ornery beast and children (probably 8 - 15 years) spend the day grazing it. The period of adjustment, however, is also fraught with technical concerns.

For example, how does one herd one or two camels. Few Samburu can afford an extra laborer to pasture a pair. During the initial phases of care, Samburu owners often try to treat the camels as they do their other species; that is, they pasture camels with cows or with goats.

Camels and cows are said to be complementary feeders. Camels are principally browsers; they feed on tall trees and shrub, and dwarf bush (see Field 1979). Cattle are principally grazers; their preference is for fresh pasture, specifically grass. While in theory, the two may be herded together without competing for resources, in practice, tending them as a single unit proves to be a chore. Cows tend to graze slowly and methodically. Together, they eat their way from one place to another. Camels, in contrast, disperse and feed individually, at a faster pace then cows. Further, in Samburu, camels carry as special fly. (Ledein?) which literally drives cows away. Camels can travel greater distances to feed but unlike cows, they cannot climb mountains, they have difficulty navigating gullies, and they cannot cross muddy terrain. The real problem for the herder, however, arises when camels have had their fill Satiated camels become playful, and sometimes antagonize other animals. Smaller cows are likely to be bruised, bitten or kicked.

The combination of camels and goats may be an even more arduous one. Camels and goats are both principally browsers, yet feed at different levels. Like camels, however, goats tend to feed in all directions-- thus creating two groups of wandering animals to tend. Goats dislike the camel flies, and, more basically, fear that the large animals will step on them.

New camel owners may also decide to farm their one or two camels out. A small cluster of more experienced elders (usually Rendille) can easily accommodate a few more camels into their large herds. These experienced camel herders provide the additional services of a bull and may oversee the first birth of their new charges. These experts receive nothing specific in return for their help. They often use the milk of the animals which have been loaned and sometimes are given a goat or sheep as a token of friendship. More generally, a bond is established between the expert and client which especially allows the former to ask for aid in the future.

At some point, the Samburu again takes over the management of his camels. This usually happens when he buys more and feels he has enough to constitute a separate herd, or when he has learned enough to manage the animals himself. The camel expert continues to play the role of guiding father, and, for many years to come, he may receive the camels at crucial times of sickness or birthing.

In brief, the new camel owner has to learn a new repertoire of herd management. Some of his concerns are technical. Particularly in the realm of health care, elders lament that they know neither how to recognize nor treat disease-- nor how to fortify the health of a sturdy animal. And some of his concerns involve socially reorganizing his work force. Tending camels means that more workers are needed and that many family members need to adapt to new roles.

Conclusions

While the Samburu have had a long association with camel peoples, only recently have they adopted camels for use in their own encampments. The introduction of camels seems to be related to a decline in their livestock economy. In the last twenty-five years, then, Samburu have lost about a half of their aggregate cattle holdings and access to a third of their grazing lands. During the

same period, population has increased by fifty per cent.

The adoption of camels, however, is still very limited. The total number of camels pales next to that of cows, and most elders have no camels at all. Those buying camels are among the wealthy, progressive herdowners. Their cattle holdings are secure. These are the elders who can afford to take risks; camels are expensive and difficult for cattle-keepers to manage.

The Samburu have yet to think of camels as more than an aid in the dry season. Camels provide milk when cows have been sent to far-removed pasture. Camels even provide food when the stores are empty of foodstuffs. Many of the elders stop milking their camels as soon as the cows return home; they "lose interest".

Basically, elders use camels to complement their cattle holdings. These richer elders don't need camels, that is, for subsistence. They say that having camels gives them greater leeway in managing their cows. They can send their cows to dry season grazing earlier, and for longer periods, than those without an alternate, ample milk supplier. Theoretically, elders are also assured that their cow calves can suck until satiated. Camels reduce the competition between milk for the calf vs. milk for the household. In practice, however, these wealthy elders have enough milking cows to satisfy the needs of all young-- children and animals. The case that camels allow better allocation of scarce milk resources would more suitably apply to households with few cattle holdings.

The progressive herdowners also invest in camels as they would in a durable, multi-purpose, profitable commodity. While the initial costs are high, elederS have seen how camels remarkably resist even severe droughts. As pack animals, camels can carry heavier loads and travel greater distances than the donkeys which the Samburu traditionally use. Further, in the long run, camels can pay handsome returns. Male offspring, abundant in meat and highly-prized fat, fetch almost twice the market price of a comparable ox.

Camels are just beginning to occupy an important role in the Samburu economy. They represent an addition, not a replacement, in the livestock repertoire. Elders buying camels continue to invest in all other kinds of stock. By adopting animals that eat higher browse, Samburu intensify their use of the land and increase their range of resources in an unpredictable environment.

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MAJOR PATHOLOGICAL FACTORS AFFECTING THE ONE-HUMPED CAMEL AND THEIR CONTROL TO INCREASE CAMEL PRODUCTION

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Introduction

Camels inhabit the more arid and semiarid regions of the world where they form an important component of an ecosystem in which the flora of usually marginal lands can be converted to human food. Because of their unique morphology and the unique dexterity of their mouth parts, camels can utilise flora usually unpalatable to other domestic livestock. In this way camels are uniquely suited to the arid environment. They can thus contribute substantially to the solution of food problems in many arid and semiarid regions where starvation and malnutrition are most prevalent.

In Africa only the one-humped camel is to be found. It inhabits the arid and semi-arid regions of the north, west and East Africa. Outside Africa, the one-humped camel (Camelus dromedarius) is to be found in Middle East, Asia and in some areas of the Baltic region. It belongs to the family camelidae (Mason, 1979).

It is generally agreed that the camel has received less attention compared to the other domestic animals. This may be due to harsh environment in which the camel livescoupled with the non-sedentary nature of the camel herders (Mukasa-Mugerwa 1981). The fact that camel rearing regions are among some of the most poverty-striken areas of the world and that they are constantly under political instability, are some of the factors to be considered.

The pathology and anatomy of the camel have received more attention than other aspects of camel medicine and biology. However, the diseases of camels have not been as extensively documented as in

the other domestic animals. Available literature indicates that the camel is not susceptible to specific diseases (Richard, 1979). Its own affections are known to the other domestic livestock, although it is believed to suffer from fewer diseases than the other domestic livestock (Leupold. 1968) and epidemics are rare. However, its symptomatology seems original, showing little diversity and difficult to characterise. Loose (1927) and Curasson (1947) emphasized the low symptomatology of this animal. Often it is said that a sick camel moves about, lies down and dies(Richard,1979). However, because of the lack of detailed clinical observations of the infecticus diseases in their acute subacute and chronic forms and the lack of studies on camel metabolism, doubt is possible as to the true cause of the low symptomatological diversity(Richard, 1979).The originality of the sick camel is defined by this quotation from Curasson (1947): "What gives the dromedary pathology its characteristic feature is less the animal itself than the environment in which it lives and the way it is bred and used". The influence of environment and breeding methods seem to explain the absence of high morbidity rates and huge epidemics among camels. However, within herds morbidity may be quite high. The low density of the camel population in their traditional habitat and the long drinking intervals lessen the frequency of interherd contacts necessary for the spread of infectious diseases (Richard, 1979). Furthermore, the camel has less contact with other domestic species.

An attempt is made to discuss the major diseases of camels. These will be classified as parasitic, bacterial, viral and malnutritional.

Parasitic Diseases of Camels

Protozoal Diseases

Trypanosomiasis is considered to be the most important protozoal disease affecting camels (Gatt-Rutter, 1967). Two main forms of the disease occur in camels, namely: that caused by *Trypanosoma evansi* (also known as "Surra") which is transmitted mechanically by biting flies, and that caused by tsetse-transmitted trypanosomes, *T. congolense*,, *T. vivax*, *T. brucei* and *T. simiae*. The disease caused by *T. evansi* is by far the most important as camels are rarely found in tsetse infested areas. Camel Surra occurs wherever camels are found. The disease causes heavy

losses among camels because it is characterised by abortions, mortality, emaciation and loss of production (Gatt-Rutter, 1967; Richard, 1975). Hyperacute, acute and chronic types of the disease have been described. The chronic form is the most common. Factors which predispose to these types and the frequency of their occurrence are uncertain. The acute type is common among the calves and the chronic type among the adults (Olaho, 1983).

Tsetse-borne trypanosomiasis can cause severe disease in camels. Bennett (1929, 1933) observed that T. brucei, T. congolense and T. vivax could cause pathogenic effects. While T. brucei and T. vivax responded to Naganol therapy, T. congolense was the most pathogenic and most dangerous. Pallegrini (1948) showed that T. simiae was pathogenic in camels. Recent work in Kenya has showed that T. congolense causes a hyperacute disease in all age categories of camels (Wilson et al, 1981); Olaho et al, 1983). Tsetse-borne trypanosomiasis could become important if camels are ranched in the proximity of major tsetse belts of Africa.

Suramin (Naganol, Moranyl) and Antrycide have been the only drugs of choice for the control of camel trypanosomiasis (T. evansi infection). However, widespread resistance to the former have reduced its use (Scott, 1973; Mahmoud and Osman, 1979; Wilson et al, 1981) and the latter has been out of market. Isometamedium chloride (Samorin), may be used against T. evansi infection in camels, but it does not effect a complete cure in some instances (Fazil and Fink, 1979; Olaho et al, 1983). However, when given I.V. the drug has been observed to control abortions due to T. evansi infection and T. congolense and T. vivax infections in camels (Rottcher 1983, Olaho 1983). Antrycide production has just resumed (by May and Baker and an Indian Company). Trials are underway to pave the way for its full-scale field use again. This is good news for camel owners all over the world. However, even after the resumption of antrycide use, veterinary supervision will be needed to avoid unscrupulous use which might lead to the development of resistance to this drug. With proper co-operation between the veterinary staff and camel owners, camel trypanosomiasis can be controlled to a minimum. This has been shown to be possible at Ngurumit (Wilson et al, 1981). The combination of both parasitological and serological methods of diagnosis could facilitate this endeavour.

Gatt-Rutter (1967) discussed the prevalence of other protozoal infections in camels. No pathogenic effects of the parasites listed were documented. These diseases included: Leishmaniasis, coccidiosis, theileriosis, sarcosporidiosis and Toxoplasmosis. It seems other protozoa play a limited role as causative agents of disease in camels. However, their pathologic role should be investigated further.

Helminthic Diseases

A large number of internal parasites have been recorded from the camel (Daynes and Richard 1974). Leese (1969) listed the frequency of occurrence of internal parasites. He observed that 'Husk' as a disease of camels in the Nile Delta, was caused by Strongylus fileria. Blaizot-Bouvier (1975) and Lodha et al (1977) also attempted to list internal parasites of camels. Infections with strongyl worms is by far the most common and frequently occurs in 90-100% of the camels in a herd. Their pathogenic effects are chronic and hard to characterise. Richard (1976) observed that acute helmiathiasis in camels (gastro-intestinal parasitism) is generally associated with anaemia, diarrhoea, constipation and emaciation. There is a disturbance in the absorption of nutrients with a resultant drop in production. Animals with chronic gastro-intestinal parasitism are immunologically depressed and easily succumb to disease. The most pathogenic strongyl worm belongs to othe genus Haemonchus which are voracious blood suckers. Graber et al (1967) found that infestations in the abomesum due to Haemonchus spp comprised 72% of the 132 camels he post-mortemed in Chad. He concluded that this parasite was the most common and most important. Other strongyl nematodes which have been found in camels in Africa include: Trichostrongylus spp., Bunostomum spp, Oesophagostomum spp. Nematodirus spp and Ostertagia spp. Transmission of the strongyles is direct.

Nematodes of the genera Strongyloides and Trichuris have also been reported (Steward 1950; Graber et al, 1967; Richard, 1975; Rutagwenda and Munyua, 1983). Though relatively common, they are normally not pathogenic except in massive infestations in young camels.

Infestations of camels with adult or larval stages of cestode worms is common. Adult cestodes include those belonging to the genera: Moniezia, Stilesia and Avitellina (Richard, 1975 Wilson et al, 1981 and Olaho et al. 1983). The most important larval stages which parasitise camels are: hydatid cysts from adult dog tapeworm Echinococcus granulosus, Cysticercus bovis the larval stage of the beef tapeworm Taenia saginata and Coenurus cerebralis the larval stage of Taenia multiceps. Dada (1978) found that 57.2% of the slaughtered camels in Nigerian abattoirs were infested. Hydatid cysts were found in the lungs, livers and spleens of infected animals and losses of what would have been otherwise parts for human consumption were considerable. In the Sudan about 35% of the camels surveyed were infected (El-Khawas et al 1979). It has also been reported in Ethiopia (Richard, 1979), Tunisia (Burgmeister, 1975), Saudi Arabia (Eldisougi, 1979) and Kenya (Rutagwenda, 1983). Hydatidosis probably occurs wherever camels and dogs or wild carnivores are in contact with each other (Wilson et al, 1981).

The incidence of cysticercosis is generally low but has been reported in Ethiopia (Richard, 1979), Chad (Graber et al,1967) and Saudi Arabia (Eldisougi, 1979). Coenurosis is rare but has been reported in camels by Burgmeister (1975). Magsoub and Kasim (1978) and Eldisougi (1979), reported the existence of Fasciola gigantica and Fasciola hepatica among camels in Saudi Arabia. They found a higher incidence of fascioliasis (liver fluke) in animals from the Eastern region and associated this with the higher rainfall and irrigation schemes in this area, conditions which favour the multiplication of the intermediate hosts. About 14.2% of camels imported from the Sudan were also found infected with fascioliasis.

Filariasis caused by Diptalona evansi has been reported in camels by Michael and Saleh (1977). This parasite inhabits the arteries especially the spermatic artery but sometimes also the pulmonary and diaphragmatic arteries.

Helminth parasites and their extent of infestation vary with location and management systems. The disease picture varies with the burden. Information on the disease picture and economic

losses caused by each parasite is scanty. However, good management coupled with regular deworming should help to control helminthiasis in camels. Recent studies in Kenya have shown that this is possible (Rutagwenda and Muyua, 1983). Panacur (Fenbendazole) was found to be effective against strongyl nematodes although it was ineffective against Trichuris spp. Lodha et al (1977), found that 90% methyridine injectable solution at 1 ml/4.5 kg and 4% Morantel tartrate 1 ml/4 kg live weight were very effective in the treatment of mixed infections of Trichuris spp, Haemonchus spp, Nematodirus spp and strongyloides spp in camels. Tetramisole hydrochloride (Nilverm) 3% W/v oral drench at 0.5 ml/kg liveweight was next best treatment, whereas thiabendazole even at 90 mg/kg liveweight did not produce encouraging results. A recent trial with invermectin injectable at 200 mg/50 kg liveweight has produced very encouraging results (Sayer, 1984).

External Parasitosis

External parasites comprise an important group of parasites effecting camels. They mainly cause intense irritation leading to loss of production. Other effects include: anaemia, secondary bacterial infection, transmission of disease agents and release of toxins. Though it is alleged that camels do not suffer greatly from tick-borne diseases, a number of tick species have been isolated from camels. Richard (1975) recorded 11 species of ticks which infest camels in Ethiopia. These include: Rhipicephalus pulchellus, R. Sinus, R. pravus, Amblyomma variegatum, A. lepidum, A. gemma, Hyalomma excavatum, H. truncatum, H. dromedarii, H. impeltatum and H. rufipes. He considered that quantitatively, R. pulchellus and R. sinus were the most important. However, Curasson (1947) and Steward (1950) considered Hyalomma spp. to be the most dominant tick in the camel. In Kenya, Hyalomma spp was found to be the most dominant at Ngurunit and Kulal in Marsabit district, while R. pulchellus was found to be the most dominant at Galana and Olmaisor (Wilson et al, 1981; Rutagwenda and Munyua, 1983). Wilson et al (1981) considered H. dromedarii to be the most important economically because it infests mainly the nose and ears causing intense irritation and inflamation.

Camel mange is sometimes considered the most important disease after trypanosomiasis. In the past only Sarcoptes scabiei var cameli (Richard 1976) was the only causative agent of camel mange. Recently Sayer and Olaho (1984) isolated a Demodex spp from camels suffering from mange on Galana Ranch. Mange is highly contagious and transmission is directly by contact or indirectly through objects such as saddles, harnesses, beddings and even tree trunks. Spread is more rapid during the cold weather when animal coats usually grow long and animals huddle together more often. Sarcoptic mange affects all ages and sexes and is certainly more severe than previously thought (Lodha, 1966). The organisms usually take 2-3 weeks to multiply after which the population explodes. Lesions usually commence on the face or flanks and spread rapidly all over the animal body and throughout the entire herd. The whole body may become infested within a month. Affected areas become alopecic, swollen, hardened, wrinkled especially in the hind quarters, thighs and hock joint areas. Because of the intense irritation, affected animals lose feeding and grazing time with subsequent loss of condition and production. Diagnosis of sarcoptic mange is easy, but Demodectic mange may be difficult especially if attention is not paid and when there is mixed infection. Acaricide application coupled with 0.05% Lindane has been reported to be effective (Lodha, 1966) at three applications of 0.05% Lindane at weekly interval, irrespective of acaricide. There are reports that ivermectin injectable 200 mg/50kg liveweight may be useful in controlling ticks, internal parasites, myiasis and sarcoptic mange. This drug is being tested on Galana Ranch to this effect (Sayer, 1984). It may be possible to control tick infestation together with internal parasites, mange, the larvae of the camel but fly Oestrus cameli and the larvae of the camel nasal fly Cephalopsis titillator with this drug at once.

Bacterial and Viral Diseases

A number of bacterial and viral diseases have been cited in literature but without strong evidence of active infection or pathological effect.

Anthrax (caused by Bacillus anthracis) was reported by Cross (1977), Curasson (1947), Richard (1976) and Eldisougi (1979). Camel anthrax is an acute or paracute disease. Fazil (1977) indicated that the disease in camels is similar to that in other species but Leese (1969) observed that camel anthrax is similar to the form observed in horses and pigs. Bremaud (1969) wrote that anthrax was particularly important in the Wajir camel herding area of Eastern Kenya. This disease is an important public health problem in areas where camel herders are used to eating camels which die from unknown causes. Clinically, affected camels show oedematous swellings of the head, throat, neck and body and is often associated with dyspnoea and difficult swallowing. Death may occur without septicaemia. Apoplectic and diarrhoeic forms have also been observed. Vaccination with the same vaccine as used in cattle e.g. Blanthrax which also protects against black quarter is possible (Mukasa-Mugerwa, 1981).

Salmonellosis in camels has been reported by Olitski and Ellenbogen (1947), Curasson (1947), Zaki (1956) and Cheyne et al (1972) in Somalia Salmonella choleraesuis has been incriminated and believed to cause a paracute disease with death occuring in a few days. It may be protracted. In the acute form, animals have elevated temperature (39°C) and pulse rate (50 per minute). Prescapular and submaxillary lymphnodes are swollen coupled with muscle twitching in the head and neck regions and diarrhoea, were observed by Cheyne et al (1977). Protracted cases (5-6 days) exhibited a thready pulse, congested mucous membranes and black, liquid, foul-smelling faeces. Mortality rate in this outbreak was 10%. Like anthrax, salmonellosis is of great public health importance. Cheyne (1977) reported food poisoning caused by infection of camel meat. They also quoted work which showed evidence of Salmonella spp. in the faeces of healthy camels, and that up to 3% of the carcasses at one camel abattoir in Egypt contained Salmonella typhimurium in their viscera. As regards treatment, favourable results have been obtained by a combination of antibiotics and sulphonamides (Mukasa-Mugerwa, 1981).

Other bacterial infections of camels include skin necrosis caused by Streptococcus spp. (Edelsten and Pegram, 1974). Fazil (1977) was of the opinion that skin necrosis in camels is particularly associated with salt deficiency. Once established the ulcers spread to the surrounding areas and there is little spontaneous healing. Cleaning with antiseptic solution e.g. 1:100 acriflavine or iodine solution together with supplimentary feeding of salt should be able to control lesions. Domenech et al (1977) observed that pyogenic skin conditions of camels in Ethiopia were associated with Corynebacterium pseudotuberculosis and Streptococcus of the Lancefield type B and A. A mixed infection associated with Staphylococcus spp. or Corynebacterium pyogens was observed. Tuberculosis is generally sporadic. Leese (1969) reported of this disease in Egypt. Earlier, Mason (1917) indicated that at one abattoir in Cairo, the incidence was 2.8%. Tuberculosis lesions were found in the lungs, livers or they were sometimes generalised. He concluded that camel tuberculosis was caused by the same bacillus as the one causing bovine tuberculosis (Mycobacterium bovis). He indicated that the close confinement of camels and cattle may be the source of cross-infection since the disease is rare in camels from purely camel herding regions. Though its incidence is low in camels, its public health importance must be noted. The role of Clostridia spp and Pasteurella spp. is uncertain and no confirmed cases have been reported (Richard, 1979). Camels are susceptible to various forms of pneumonia. However, the precise aetiological agents have never been elucidated. The term "dromedary-respiratory disease-complex", has been used where a variety of organisms have been implicated. Brucellosis is an established disease of camels through serological surveys (Richard, 1975; Waghela et al, 1978; Okoh, 1979; Wilson et al, 1981) but the role of this disease in causing abortion is not certain. Tetanus has has also been reported, Morcos (1965).

Camel pox, the most important viral disease of camels occurs mainly in young camels (6 months to 2 years) and is common during the rainy seasons (Cross, 1917). The camel pox virus is closely related to other variola poxes (Fazil, 1977). The characteristics of the Kenyan camel pox virus are described by Davies et al (1975) and may be of zoonotic importance as minor

lesions have been reported in humans. The camel pox can cause mortality in calves and is associated with the formation of pox lesions: papules, vesicles, pustules and crusts at many sites on the body. The head area is the most affected. The incubation period is about 2 weeks. In young camels there may be diarrhoea. Animals recovering are immune for life. nursing calves attain some degree of immunity through colostrum for the first few months of life. A vaccine to control this disease has been proposed (Richard, 1979).

Rinderpest infection in camels has been reported (Eldisougi, 1979). The virus causes a slight temperature and stimulates immune response (Sing and Ata, 1967; Taylor, 1968). Clinical lesions have been reported in literature by Richard (1975). Though there has been serological evidence of rinderpest in camels, the role of the camel in the epidemiology of the disease in cattle is minor and uncertain. There is doubt whether camels are full susceptible to the rinderpest virus.

Though foot and mouth disease has been reported in literature (Eldisougi, 1979; Richard, 1979), the susceptibility of the camel to the FMD virus is still doubted.

In Kenya, antibodies to the Rift Valley Fever (RVF) virus were detected in camel sera originating from two widely seperated areas in northern Kenya. The incidence in various age groups was similar and large scale abortions were attributed to the outbreak (Scott et al, 1963).

Malnutrition

Although camels can survive under harsh conditions, under very poor pasture conditions, their feed should be supplemented Leonard (1894). There is little information on the effect of malnutrition in camels. However, Fazil (1977) observed that salt deficiency in camels was particularly associated with skin necrosis. Wilson et al (1981) observed that malnutrition was a serious problem in some herds in Kenya. This condition was observed to be associated with emaciation and loss of production.

Conclusion

The camel is susceptible to a number of pathological conditions. Few detailed studies have been carried out to allow proper classification of these conditions in terms of their frequency, severity or economic importance. Richard (1979) tried to classify camel diseases according to numerical frequency, severity and economic importance. According to numeric frequency: myiasis of nasal cavity (Cephalopsis titillator) was the first, followed by internal parasitism (Strongylosis and cestodosis), trypanosomiasis or mange according to area, pyogenic diseases (corynebacteriosis, streptococcosis) and wounds, camel pox, nutritional deficiencies, pulmonary diseases and anthrax. Qualitatively according to severity: trypanosomiasis due to T. congolense, T. simiae and T. brucei (rare but deadly) was the first followed by, anthrax, trypanosomiasis due to T. evansi, myiasis with nervous disorders, pyogenic diseasee, nutritional deficiencies, internal parasitism, pulmonary infections camel pox and mange. Lastly, according to the economic importance: trypanosomiasis was the first, followed by internal parasitism, mange, pyogenic diseases, nutritional deficiencies, pulmonary infections, myiasis, camel pox and anthrax. This classification does not apply to every region. Eldisougi (1979) listed mange, pneumonia, hydatidosis and ticks as the major ailments of camels in Saudi Arabia. In Kenya, Wilson et al (1981) considered trypanosomiasis, internal parasitism, mange, malnutrition (especially in calves), and camel pox as important diseases of camels.

The effects of these pathological conditions are seen in mortality which means a low numeric production rate, a low, nil or negative herd growth; abortions which entail a low fertility rate with the same effects as mortality; anorexia and loss of condition which give low yield of milk and meat which can also affect the fertility rate and end in death. A short sickness can affect the animal's ability to produce (milk or meat) for a long time. A she-camel with a slight fever due to trypanosomiasis lasting a few days will not reach again the milk production level that it had before. The lactation will go on at a lesser yield rate. This illustration helps to emphasize the need to maintain healthy

camel herds. The need for veterinary input is strongly emphasized here. A systematic treatment against disease e.g. trypanosomiasis, internal parasitism and ectoparasites must be encouraged. The use of the drugs e.g. trypanocides and antibiotics must be controlled to avoid drug abuse and the development of drug resistant strains. Pregnant and young camels must be given priority in all these endeavours. Vaccination where possible could also be encouraged.

Alongside these measurements, research must be undertaken to extend the scope of knowledge about camel diseases and their control, camel nutrition camel metabolism, and camel herd economics.

Lastly, in any effort aiming to improve camel productivity and the welfare of the camel pastoralists, while at the same time seeking to protect the ever heated arid ecosystems in which most camels are raised, a co-ordinated, multidisciplinary approach appears necessary. In the words of Pratt and Gweynne (quoted by Mukasa-Mugerwa, 1981): "success depends on a balance between ecology, sociology and economics and the availability of administrative personnel capable of achieving-this balance".

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THE STATE OF OUR KNOWLEDGE ON CAMEL DISEASES IN NORTHERN KENYA

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Summary

The paper reports on the studies conducted by UNESCO/IPAL on camel diseases from 1978 to date. Important diseases of camels, their incidence and control measures are given. Recommendations on a control strategy which can be adopted in a nomadic situation are also discussed.

Introduction

The dromedary or one-humped camel (Camelus dromedarius) is thought to have been first domesticated about 3000 years ago (Buillet, 1975). This domestication took place in Arabia and spread to other areas after that. Curasson (1947) indicates that after the camels had been introduced to North Africa from Arabia, they spread west and southwards from where they reached Northern Kenya. Contrary to earlier beliefs (Gatt-Rutter, 1967) that the camel does not thrive south of a line drawn from the Senegal River through North Nigeria, Lake Chad, Bahr-el-Ghazal and Northern Kenya, camels are at the moment found in places like Galana Ranch which is further south of the equator than he originally thought.

There are 17 million camels in the world, 12 of which are one humped or the dromedary type. The camel population in Kenya, according to recent estimates of Stelfox et el, (1979), is about ½ a million. Most of these camels are kept by nomadic pastoralists while others are kept in ranches in other parts of the country. The Kenyan camels are of 3 breeds, the Somali, the Rendille or Gabbra, and the Turkana. Camels are essential for subsistance of the nomadic pastoralists who keep them. They provide milk and remain in milk longer and are hence more reliable during extreme dry seasons than either cattle or small stock. Camels provide meat to the nomadic population, they also provide blood which is an important iron source. Although camels are not slaughtered for meat on a commercial basis, pastoralists slaughter sick camels, and eat them during period of extreme difficulty, pastoralists can slaughter camels and use the meat to exchange for goats or other items badly needed. (Karaba pers. comm).

In addition, camel milk contains higher proportions of vitamin C than either cow or human milk and this is very important in arid areas where the green vegetable source is not available.

Camels are used to cement relationships between nomadic communities and are usually exchanged as loans or gifts. The Rendille people of Northern Kenya attach a lot of traditions to their camels, and a lot of festivities are connected with camels. There being about 4 ceremonies ("Soriu") where all the camels both homestead and "fora" herds return to the main camp to be blessed.

The adaptation of the camel to the desert environments has been studied by various scientists. Diseases of camels have also been studied in Ethiopia (Richard, 1979) Somalia (Steward, 1950) and in Northern Kenya (Wilson et al, 1981, Rutagwenda, 1982). When compared to other livestock species, diseases of the African camel have not been exhaustively researched probably due to the non sedentary nature of the herds, always moving in search of water and pastures. Consequently, there have been few reports of diseases and even those that are available are either based on isolated disease outbreaks or on surveys of randomly selected herds. There have been few studies of any duration on the epidemiology or control of diseases in camels.

Unesco's Integrated Project on Arid Lands (IPAL) since 1978 has been carrying out studies on camel diseases in Northern Kenya. The first of these studies (Wilson et al, 1981) was aimed at identifying the most important diseases of camels in the IPAL study area. The second study (Rutagwenda, 1982) was aimed at finding out the effects of a simple veterinary drug package on the most important diseases of the area. The last study was aimed at recommending on a control strategy which can be adopted by the nomadic pastoralists to control these diseases in Northern Kenya (Unesco, 1982) and to find out how the nomadic population responds to such recommendations. (Rutagwenda, in press). The aim of this paper is to highlight the results of these studies.

Materials and methods

Study area.

The first two investigations viz: Disease study and Disease control were carried out in Ngurunit area ($1^{o}50'N$ and $37^{o}13'$ E). The geography, geomorphology and vegetation of this area are given in

Unesco (1982). The third study involves data collected from regularly held veterinary clinics (Rutagwenda, 1983) in various centres in the study area.

Table 1: The number of animals used in these studies

Phase	Type of study	Animals studied			
		Calves 0-1 year old	Immatures 1>1 years	Adults < 4 years	Total
I (1978-1981)	Disease investigation	7	46	121 (80)	174
II (1981-1982)	Disease control study T	14	13	33 (30)	60
	C	2	19	39 (31)	60
III (1983 to present)	Application of findings of I & II in form of vet. clinics	8	20	34 (29)	62
		nomadic camels presented for treatment			

Numbers in brackets = Females above 5 years of age.

T = Treatment herd.

C = Control.

The numbers of animals differed during various studies. During the first phase (1978-1981), studies were done on a herd belonging to an Arrial Rendille of the Masula clan who had allowed his camels to be tagged and regularly studied. In the second phase (1981-1982), he loaned 60 camels on a contract to the Project to be studied and these received veterinary treatment in form of a package.

The control herd was purchased by the project in this area with an assumption that the camels had had similar treatments before. As it was difficult to buy camels with their calves, immature camels were bought so as to have the two herds in numerical balance.

In the Third phase, the project maintained its control herd used in phase 2 but received treatment. In addition, data was collected from veterinary clinics held monthly in various centers within the IPAL study area.

Samples taken during the studies and laboratory procedures used.

In the first phase, only samples for disease studies were taken to establish information on diseases, with no treatment. In the second phase, two herds were studied one receiving veterinary treatment and the other one not receiving any treatment. That is, the same procedures for the disease studies were carried out for both herds with only one herd being treated. In the Third phase, information was gained from data collected from animals presented for treatment on a monthly basis.

In the first 2 phases, the following samples (Table No. 2) were taken.

Table 2: Samples taken during the studies and laboratory analyses.

Sample taken	Reason for taking the sample	Frequency	Laboratory procedure used
Unclotted blood sample	(1) Packed cell volume determination for	Once every two months	Microhaematocrit method (Schalm, et al 1975)
	(2) Mouse inoculation for detection of trypanosomiasis		Standard procedure
	(3) Preparation of blood slides		Standard procedure
	(4) Differential cell counts RBC & WBC		As described by (Schalm et al 1975)
Serum sample	Antibody detection for Trypanosomiasis		Mercuric chloride test (Bennet, 1933) Indirect Haemaglutination Test (Walther & Glosklaus 1972).
Faecal sample	(1) Faecal egg count	Once every month	Modified McMaster (Rutagwenda, 1982)
	(2) Larval culture	Once every 3 months	Modified McMaster (Rutagwenda, 1982)
Post mortem worm counts	(1) Identify various nematodes	As and when death occured	Eysker Method (1978)
Tick counts and collection	(1) To establish the relative tick loads	Once every month	Hoogstral (1956) method
	(2) To identify tick species		

Table 2. Continued...

Sample taken	Reason for taking the sample	Frequency	Laboratory procedure used
Antemortem Examination	To find out cause of sickness	As disease was suspected	Standard procedure
Post mortem	To find out the exact cause of death	When death occured	Standard necropsy procedures. Sections, fixed and stained for histopathology
Body weight estimation	For purpose of accurately calculating drug dosages	Monthly	Method described by Field, (1979).

Treatment given to the treated herd in phase 2

During the second phase, treatment was given more or less on a regular, routine basis. During the subsequent phases however, treatment was given only to sick animals presented for treatment. The following treatments (Table 3) were carried out in phase 2.

Table 3: Treatment given to the treated herd

Disease condition	Drug and frequency
Trypanosomiasis	Naganol(R). All animals once and only positive animals were repeated.
Internal helminths	Panacur(R) For round worms once every 4-8 weeks. Mansonil(R) For tapeworms when detected.
Ticks and mange	Acaricide once every week, together with tick grease in the nostrils and weekly scrubbing of Acaricide on areas affected with mange.
Miscellaneous conditions	As they occured using recommended drugs.
Anthrax	Animals were twice vaccinated against anthrax.

Results

Anaemia

Packed cell volume (PCV) was used as a measure of anaemia using values for Sudanese camels as a reference. (Salaheldin et al, 1979). During phase 1, PCV values for the Ngurunit herd were below normal values. The white blood cells, showed leucocytosis which was characterised by lymphocytosis and eosinophilia. The Red blood cell counts and haemoglobin concentration were normal during the study period. During the treatment phase, PCV's of the two herds of camels were compared.

Table 4: Mean PCV of the 2 herds analysed by a t-test.

Date	Mean PCV ± S.E. for Treated herd	Mean PCV ± S.E. for Control herd
May 81	21.8 ± 0.57	21.7 ± 0.39
July 81	26.1 ± 0.64 *	23.2 ± 0.65
Sept 81	28.2 ± 0.56 *	25.0 ± 0.62
Nov 81	27.1 ± 0.45 *	24.8 ± 0.55
Jan 82	27.8 ± 0.44 *	25.7 ± 0.59
Mar 82	28.2 ± 0.47 *	25.8 ± 0.37
May 82	28.0 ± 0.35 *	24.8 ± 0.38

* significance $P < 0.01$.

The results show that mean PCVs of the two herds at the beginning of the study period were similar. But as treatment started soon after May, there was a difference which was significant statistically at the 1% significance level. Haematological parameters were monitored but are not included in this report.

Trypanosomiasis

The incidence rate of trypanosomiasis in the camel herd according to detection of circulating antibodies and patent parasitaemia was 79.4% and 9.7%. The trypanosome type identified from infected mice was T. evansi. During the treatment phase, point prevalance rates were used to study the pattern of disease using mouse inoculation test, mercuric chloride test and indirect haemagglutination test. Results showed a low prevalence of the disease in camels. In later studies however, a high prevalence was detected in an area where the camels had moved to which was a different site from their previous home.

Internal parasitism

Strongyle eggs were present at very high incidence levels in adults and immature animals of the herd. Calves showed eggs in their faeces at about 1 year of age. It was observed that strongyle egg output was higher in adult females than males.

During the second phase, strongyle eggs of the two herds were compared and there was a significant difference between strongyle egg levels of the 2 herds from the time treatment was initiated up to the end. Results of mean strongyle egg counts in different age groups of the untreated animals showed that calves had lower strongyle egg counts than the adults and immature animals were in between these two levels. Strongyloides Trichuris, Monieza and Coccidia eggs were also detected in camels during the study but not at higher incidences as for strongyle eggs. Faeces cultured from the untreated animals showed that Haemonchus conturtus was the most common strongyle worm observed. Trichostrongylus and Oesophogostomum were also present at low levels. The importance of Haemonchus was also confirmed at postmortem when it was the only nematode collected from animals dying of acute intestinal parasitism.

External parasites

Studies on external parasites showed that tickloads were higher ($P<0.01$ in the untreated animals than treated ones from the time of acaricide application to the end. The main predilection sites of ticks included the nostrils, ears, inguinal area and tail switch. From this study, six species of ticks, 3 of Hyalomma, 2 of Rhipicephalus and 1 of Amblyomma were identified. Hyalomma species accounted for 96% of the total ticks while Rhipicephalus species accounted for 2.4% and Amblyomma species 1.6% of the total tick population. Hyalomma dromedarii accounted for 68.7%, Hyalomma rufipes 21.7%, Hyalomma truncatum 5.6%, Rhipicephalus pulchellus 2.2%, Rhipicephalus pravus 0.2% and Amblyomma gemma 1.6%. Hyalomma dromedarii had its main predilection sites in the ears and nostrils, while other ticks showed preference for inguinal area and tail switch. Studies showed that weekly application of acaricide was enough to bring down the effects of ticks on camels and deleterious effects of ticks were only seen on the untreated animals where 20% of calf mortality was due to anaemia resulting from severe tick infestations. Other parasites included Sarcoptes ss scabei var cameli causing mange especially in calves, but animals in the

treated herd responded very well to the mode of treatment that was given for camel fly of the family Hippobosidae which was common; no studies of this fly were carried out.

Table 5: Mortalities on both herds

Cause of death if known	Treated herd n=10 Calves	Immatures	Adults	Untreated herd n=15 Calves	Immatures	Adults
Malnutrition	1	-	-	4	-	-
Predators	1	-	1	-	1	2
Pneumonia	1	1	-	-	1	-
Chronic Trypanosomiasis	-	-	-	-	-	1
Chronic Enteritis	-	-	-	-	1	-
Hydatidosis complicated with pneumonia	-	-	1	-	-	-
Hydatidosis complicated with haemonchosis	-	-	-	-	-	1
Rupture of the urinary bladder	1	-	-	-	-	-
Acute bloat	-	-	-	1	-	-
Heavy tick infestation	-	-	-	2	-	-
Undiagnosed acute condition similar to ephemeral fever	2	-	-	-	-	-
Undiagnosed	1	-	-	1	-	-
Total	7	1	2	8	3	4

Other disease conditions encountered included pneumonia, myiasis, enteritis, lymphadenitis, bloat and heavy tick infestation but no detailed studies of these were carried out. Post mortem examination was carried out on 25 animals that died during the experimental period and the results are shown in Table 5.

Results confirm the importance of malnutrition in calves and this is probably due to competition between man and calf for milk, especially during drought periods. The importance of pneumonia, also during the heavy rains following long droughts need not be over emphasized. In the untreated herd, chronic trypanosomiasis, hydatidosis complicated

with chronic enteritis, bloat and severe tick infestation were confirmed to cause death in camels. In terms of numerical increase, the study showed that treated animals gave birth to more calves, lost fewer animals and at the end of one year of treatment, there was an increase of 11 animals (18.3%) to the herd whereas the untreated herd, lost more calves and had a net decrease of 5% in one year.

Discussion

This study confirmed, in Northern Kenya, the importance of camel diseases which have been reported in other camel rearing countries. Trypanosomiasis, internal parasitism, ticks and mange, as had been reported in Ethiopia, (Richard, 1979) were the most common diseases. In Northern Kenya however, malnutrition was identified as an extremely important condition which in Ethiopia did not rank among important camel conditions. In Northern Kenya, the rainfall is unreliable and low and does not support arable agriculture in Rendille country. Hence man depends on his animals for survival and in times of drought, stiff competition exists between man and calf for milk and a lot of calves die because of starvation. This can be alleviated through feed supplementation. The introduction of imported feed supplements might not be economical but the harvesting, storage and feeding of Acacia tortilis pods is envisaged and can be a good remedy to the situation.

Haematological results showed anaemia, which could be caused by ticks, helminths and trypanosomes. Animals in the treated herd had higher packed cell volumes, indicating a control of these parasites and hence a better anaemia status. Other studies on haematology showed leucocytosis which was characterised by lymphocytosis and eosinophilia. This indicates chronic blood loss and sustained immunological stimuli. The former could be caused by internal and external parasites while the latter is caused by trypanosomiasis. Only T. evansi was isolated from camels in this area and this indicates that tsetse flies may not be important in transmission of the disease. The incidence of antibodies to trypanosomiasis shows that most animals had some contact with the disease and this implies that the disease exists in an endemic state. However, there can be upsets in the endemic state resulting in an epidemic, as has been cited in other areas of the country. (Olaho pers. comm.) There are 2 drugs that are recommended for camels. Antycide and Naganol (Suramin). The former is no longer available and the latter is expensive and, if used

without due care, resistance can occur. The situation regarding camel chemotherapy to trypanosomiasis is therefore not very good but Naganol, if used with care, as was shown in this study can result into better herds by reducing abortions which appear to be associated with trypanosomiasis.

Haemonchus was the most common internal parasite seen. High levels of strongyle eggs were detected in the adult females of the herd which suggested a stress factor existed, caused by nomadic pastoralists competing with calves for milk. This study showed that fenbendazole is a very good anthelmintic for camels, and based on the knowledge of rainfall pattern of the area, strategic dosing of camels is possible and is greatly recommended. Dosing all camels at the beginning of the dry season and two months after the onset of the wet season is quite adequate both economically and can reduce the effects of these parasites to a large extent.

A lot of ticks were found on camels but this study showed that weekly application of acaricides during the treatment phase can reduce the effects of ticks on camels. Mortality in the herds showed that trypanosomiasis, predators and malnutrition were serious causes of death and there was a high incidence of calf mortality.

From these results, it is clear that the control of the principal disease conditions of the area / involve proper management and incorporation of a simple veterinary drug package.

Proper management can involve nutrition whereby Acacia tortilis pods can be supplemented to the diets of calves during droughts. Milking procedures can also be rectified to reduce the competition that exists between calf and man. The veterinary package includes the strategic control of trypanosomiasis by administration of Naganol to confirmed positive cases and strategic dosing of camels twice a year depending on the rainfall. Ticks can easily be controlled through application of acaricides through either hand dressing or spraying, both of which are very cheap operations. This study, however, showed that animals which were treated benefitted so much, as to increase in number by about 18%. This, therefore, calls for strategic offtake, to remove excess animals from the range, so that the process of desertification in Northern Kenya is not hastened.

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APPENDIX

THE LIST OF COMMON DISEASES AND CONDITIONS OF LIVESTOCK IN VERNACULAR

ENGLISH NAME	BORAN/GABRA	RENDILLE	SAMBURU
Trypanosomiasis	Gandi	Omar	Sarr
C.C.P.P.		Churr	Ilbus
Tick infections	Shilmi	Vhilim	Mangeri
Mange	N'giran	Haddo	Bebedo
Intestinal Helminthiasis	Dhadi	Deyan	Ndumai
Camel Pox	Kolmoman	Yahri	Ndubi
Abortion	Sales	Lugut	Kebirua
Diarhoea	Albati	Harr	Ngorotit
Black quarters	Harka	Khanid	Khanid
Rabies	Nyanye	Sugeri-Karare	Nyeildin
Haemorrhagic Septicaemia	Silisa		Nolgosso
Bloat	Fur-fur	Fur	Mberiri
Ring-worm	Robbi		Ngammyeni
Foot rot	—	Lgulup	Ngugeni
Three day Fever	Butt	Dhowoho	Lokirkir
Orf	—	Afuturo	Afuturo
Photocensitization	Gadile	Nyala	Sabai
Rinderpest		Sugeri Hara	Lodwa
Snake bite	Bof	Hadodo-Hi-Tof	Laburai Otonyo
Anthrax	Chita/chilmale	Renk-Hara	Lakuchum
Foot and Mouth	Oyale/oryale	Gulub	Lugulub
C.B.P.P.	Sombes	Likiba	Ilkibai

CAMEL PRODUCTION IN KENYA

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INTRODUCTION.

It has been estimated that at the present rate of growth (3.5% p.a.) the human population of Kenya will number over 18 million by the end of this year which is an increase of 19% since the last national census in 1979. Furthermore, by the turn of the century it is expected that the population will have doubled and will be increasing at the rate of more than one million per annum. In fact, in less than half a century (i.e. within the lifetime of some of the participants at this workshop!) five people may be attempting to survive where only one exists in Kenya today.

Unfortunately the National Economy is growing at a much slower rate than this, which means that progressively more people will be forced back to the land and a subsistence survival. (In 1975 the gross national product per capita was US $172 which was only 14% of the World average.) As the remaining relics of high and medium potential land are occupied there will be an intensification of the use of semi-arid lands of marginal agricultural potential. There is little hope for the survival of forests and woodlands; water conservation will be forfeited and there will be accelerating dessication of the land.

Nevertheless there may remain, in Northern Kenya in particular, extensive rangelands which cannot be cultivated because of irregular and unreliable rainfall. These, for a while, will form the basis for the National Livestock Economy.

To make way for more efficient agricultural production systems it may be tempting to transpose the existing cattle economy from the Kenya Highlands to these rangelands. However, this should be strongly resisted in the knowledge that time is not in our favor. For example, it has taken 60 years to select from indigenous cattle

(Bos indicus) to produce the highly productive Boran breed which is being ranched on medium potential land in Kenya today.

Indeed, in the arid zones where water is at a premium, water dependent livestock such as cattle should be discouraged as they are presently contributing to the elimination of the herbaceous layer in localized areas of annual vegetation around permanent water points in the sub-desert and to severe damage of perennial grassland and woodlands in watershed areas, leading to increased loss of rainfall and to soil erosion.

Instead, greater emphasis should be placed on improving the productivity of the camel (Camelus dromedarius) which is adapted par excellence to arid and/or degraded conditions and which shuns the more humid regions where camel diseases are a problem.

Much has been written about the camel as a transport animal and how during Roman times it was replaced in north Africa by wheeled transport, only to regain its former status when roads fell into decay with the fall of the Roman Empire (Bulliet, 197). A less well appreciated aspect of the camel however, is that it has the capability of converting poor quality arid rangeland forage into milk and meat. Furthermore, the milk of Camels frequently forms the staple diet of pastoralists living in the arid zone of Africa and the Middle East.

It might be construed that the camel is outmoded from the point of view of modern transport (although even this is questionable with the rising cost of fossil fuels and vehicle maintenance) and therefore does not have a role to play in the modern World. On the contrary, arid and semi-arid lands suitable for camels occupy 48 million Km2 or 36% of the earth's surface and are inhabited by 384 million people. Over the past fifty years, much of the usable land in these dry regions has been converted into unproductive waste by a combination of ecological and socio-economic factors and it has recently been estimated that the lives of 150 million people, in Africa alone, are being threatened by drought. Thus the camel is becoming increasingly in demand by virtue of the fact that it can continue to produce food for people living in a degrading environment and achieves this with minimal impact and disturbance to the ecosystem.

LIVESTOCK POPULATIONS.

All domesticated species of livestock which are found in Africa today have been introduced from adjacent areas. Among them it is noteworthy that camels, although perhaps the last to be introduced, have occupied an ever increasing niche such that there are now more on this continent than anywhere else in the World. (see Table 1)

Table 1:

World, Africa and Kenya Livestock Statistics.

Species	World	Africa	% of World	N.E. & E. Africa	% of Africa
Cattle	1,150,508	149,227	13	68,796	46
Sheep	1,056,684	143,301	14	DNA	DNA
Goats	391,375	114,735	29	DNA	DNA
Camels	16,990	12,190	73	9,838	81

Figures are in thousands of head.
Source F.A.O. 1972, 1973, 1978.
D.N.A. - Data not available.

It is thought that the dromedary was first domesticated in Southern Arabia about 4,000 years ago but was soon introduced to the Horn of Africa (the North East and East) where the largest concentration of this species is found today (see Table 1).

Placed in this perspective, it is clear that with the exception of the camel and possibly the goat, man has introduced to Africa species of livestock which have been domesticated under temperate and sub-tropical conditions and which have been only partially successful in adapting to African conditions. Cattle and sheep in particular, occupy highland areas where as mentioned earlier, they are likely to become victims of the expanding human population and agriculture.

While cattle are presently the mainstay of the African livestock economy, problems lie ahead for countries which do not seek alternatives such as the camel. Africa, with one tenth of the world's human population, has one quarter of its grassland and one eighth of its cattle (Table 2). However, per unit area beef production is 20% and milk production 10% of the world's average, Cattle stocks are growing less rapidly than the world's as a whole (Table 3). Beef and total meat production per head of population, which is already very low, is declining although milk production is reportedly keeping abreast with the human population (Crotty, 1980).

Table 2:

Percentage of the World's total accounted for by Africa.

Human Population	10.2
Arable Land	14.3
Grassland	26.4
Cattle	12.6
Beef	5.4
Milk	2.6

Table 3:

World and Africa Growth Rates (%)

1961-5 to 1974

	World	Africa
Population	21	30
Cattle Stocks	19	12
Beef Production	35	17
Milk Production	20	29
Total meat	40	22

Source Tables 2&3 Crotty (1980).

In the decade between 1961 and 1972 it appears that the World's population of camels was increasing at a slightly faster rate than other species of livestock. (Table 4)

Table 4: World Growth Rates of Livestock 1961-1972.

Cattle	19%
Sheep	18%
Goats	12%
Camels	22%

This might be attributed to a number of factors including a rapidly expanding camel habitat, low offtake rates, use of camels for subsistence only and improved census methods. One or all of these factors may have played a part in the recorded increase, amounting to 89% over ten years (1968-1978), in camels in Somalia which at more than 5 million, is the largest herd of any nation (SOMAC/SAREC 1982).

According to KREMU (1978) there were 607,000 camels in Kenya in 1977. These comprised 3.5% of the world's total population. More than half (62%) of the population of camels in Kenya is found in North Eastern Province and Isiolo District and these may be regarded as an extension of the greater Somalia population. The Gabbra and Rendille of Marsabit District are distantly related to Galla and Somali camel cultures and own approximately 19% of the national herd, while the Turkana and Pokot in Rift Valley Province own 16% having acquired camels relatively recently. The Samburu own the remaining 3% being in the process of building up camel herds as their rangeland becomes progressively degraded by cattle (Stiles, 1983).

To further narrow down the field, ten aerial surveys carried out by IPAL between 1976 and 1979 revealed an estimated mean population of 41,400 camels in 23,000 Km^2 of Western Marsabit District, They occurred at a mean density of 1.8 Km^{-2} and when converted into Tropical Livestock Units (T.L.U) comprised 36% of the total Livestock Units in the area. We have therefore been examining approximately 7% of Kenya's population of camels. Within this area a detailed management strategy has been developed for camels occurring in 11,300 Km^2, which approximates to the home range of the Rendille people. Here, there appear to be two interrelated pools of livestock, namely the Northern Rendille based on Kargi who own an estimated 8,664 camels and the Southern Rendille based on Korr who own an estimated 9,979 camels.

corr 1.8 km²

Household Ownership of Livestock

Stock Holding.

We have adopted two methods for determining stock ownership. The first uses data from the aerial census of livestock and the National census of the human population. The second has involved more than 150 household surveys among Rendille, Ariaal and Samburu. Results, are shown in Table 5 and 6.

Table 5: Stock Ownership in the Western Marsabit Management Area From Aerial Survey Data

Number	Density Corr Km^2	T.L.U. (a) %	Number Owned Per person (b)	Per family (c)	Units Per family
18,643	1.65	40.3	1.4	11.6	14.5
24,552	2.17	42.4	1.9	15.2	15.2
107,547	9.52	16.9	8.3	66.7	6.1
235	0.02	0.4	0.02	0.1	0.1
150,977	13.36	100.0	11.62	93.6	35.9

Note. a) 1xT.L.U. is equivalent to a 250 Kg cow; 0.8 of a camel or 11 Smallstock.

b) A population of 18,900 Rendille people is used.

c) A figure of eight per family is used.

Table 6: Stock Ownership in Western Marsabit District Based on More than 150 Household Surveys.

People per family	Camels	Cattle	Smallstock	Total
8	12	11	101	
T.L.U.S.	15	11	9.2	35.2
T.L.U.S. as %	42.6	31.3	26.1	100.0
adjusted for IPAL area	14.4	7.3	9.6	31.3

In Table 6, the age specific composition of the herds of each species, together with data on weights and age have been used to calculate mean liveweight. Since these are lower even than the Tropical Livestock unit, adjustments have been made, where a Marsabit camel = 1.2 TLU, a cow = 0.66 TLU, a sheep = 0.09 TLU and a goat = 0.10 TLU

Thus an average 31-36 Tropical Livestock units are owned per household and camels comprise between 40 and 46% of the total.

Analysis of camel herd structure by five different authors over a period of nine years is summarized in Table 7.

Table 7: Percentage Composition of Camel Herds = S.D.

Mature males	5.2 ± 2.28
Castrates	12.0 ± 2.55
Mature females	55.0 ± 11.42
Immatures & Calves	27.8 ± 12.56

Because of Seasonal peaks of parturition, the most variable category is the calves and immatures.

Since 55% of all camels are adult females and about half are lactating at any one time then on average, each household would have 3.2 to 3.3 lactating camels.

Minimum requirements in livestock equivalents

The average family, of about eight persons including Children, is estimated to have dietary requirements equivalent to 6.5 adults (Brown 1971). Calorific requirements for pastoralists have been estimated at: from 2000 Kcal. for a woman, to 2,800 Kcal. for a man. (Dahl & Hjort 1976). However, Brown (1971) believed that a pastoralist may be described as 'an active individual doing no heavy work' and having a requirement of 2,300 Kcal per day. Thus family requirements are variously calculated as ranging from 15,000 Kcal (Brown 1971) to 18,300 Kcal (Dahl & Hjort, 1976) after adjusting to the larger family size. Protein requirements are believed to be about 422 grams per day for a family of eight.

Brown (1971) suggests that over the year in most pastoral societies in Africa, a diet of 75% milk and 25% meat is a good estimate and that for a standard family this would amount to 16 litres of milk and 2.41 Kg of meat. In any event many families supplement their diet with cereals and we will return to this important point later.

According to Brown (1971) a family's daily milk requirements can be supplied by about 7 cows or 4 camels in milk on any and every day of the year, but in order to maintain this level of production a pastoralist must keep 35 to 40 cattle, but less than half this number if camels (Lamprey 1983). He concludes that however the figure is calculated, a family of eight persons must maintain 15-17 Standard Stock Units of 454 Kg live weight each. This is equivalent to 27 to 31 Tropical Livestock Units. If these figures are adjusted to the smaller size of animals in the study area, equivalents lie within the following ranges (Table 8).

Table 8

Liveweight & Household Requirements of Livestock in Marsabit District.

Species	Mean Liveweight in Kg	T.L.U.'S	Household Requirements Range
Camels	300.6	1.20	22.6 to 25.7
Cattle	164.7	0.66	41.3 to 46.9
Sheep	23.7	0.09	287.3 to 325.6
Goats	24.8	0.10	274.6 to 311.2

As we have seen from Tables 5 and 6, average stock ownership does provide at least these minimum requirements. In practice however, people usually keep smallstock and either camels or cattle and less commonly all three categories. Also to provide for disasters such as drought, disease and raiding and for social reasons, pastoralists try to keep rather more animals i.e. 36 to 44 Tropical Livestock Units. Clearly, the average figures shown in Tables 5 and 6 embody considerable variation in stock ownership in terms of numbers, species and individual productivity which will dictate whether or not a household will be dependent on food aid.

It is now necessary to examine the productivity of camels in Marsabit District to determine to what extent they are able to fulfill human requirements and whether they are more efficient than other livestock categories in this respect.

Productivity of Camels.

Monitoring of herds

The production of meat and milk by camels has been monitored by us in some detail in Western Marsabit using our own experimental herds. Liveweight gain and daily milk yields have been recorded over a period of two and a half years in three herds.

Results have been compared with less detailed information from two ranches in Kenya. Information concerning the five herds and their management status is given in Tables 9 a and 9b.

Table 9a

Camel Herds Monitored for Productivity Data

Herd	Locality		Period of	Altitude	Mean Annual
	Place	District	Observation	in metres	Rain in mm
1	Kulal	Marsabit	1976-80	667	200-300
2	Ngurunit	"	1981-83	750	250-450
3	"	"	"	"	"
4	Olmaisor ranch	Laikipia	1983-84	1890	580
5	Galana ranch	Kilifi	1984	270	300-550

Table 9b

Status of Camel Herds

Herd	Approximate	Breed	Status		
	Number		Veterinary input	Food	Salt
1	20	Mixed	When necessary	Not limiting	In range
2	60	Mixed	Traditional only	Seasonally limiting	Nil
3	60	Rendille	Weekly	" "	Supplement
4	200	Turkana	When necessary	Not limiting	"
5	200	Somali	" "	" "	"

From these tables it can be seen that conditions for Herds 2 and 3 differ only in the availability to the latter of weekly veterinary input and salt. Direct comparisons are therefore valid, while we can only make inferences regarding differences between the other herds.

Milk Production in Kenya

Milk production has been estimated by separating the calf from its mother for a known period of time and milking half the udder usually both morning and evening. From this the total daily yield including the amount the calf has suckled can be calculated. (Table 10)

Table 10

Camel Milk Production from Five Herds (in Litres)

Herd	Mean daily Yield	Range	Total Production over 12 months
1	4.1	N.A.	1,499
2	2.2 ± 1.18	0.7-3.8	799
3	3.1 ± 1.22	1.7-5.9	1,139
4	2.8 ± 0.50	1.9-3.6	1,033
5	5.3 ± 1.50	3.9-8.2	1,945

The highest yields were from Herd 5 where feed was not limiting and the camels were of the large Somali breed. At the other extreme, productivity by Herd 2 was only 41% of the former. These camels experiencing a seasonally limited food supply, were of the small Rendille breed and did not have the benefit of veterinary care. The advantages of the latter are shown in Herd 3 whose only major difference from Herd 2 was a regular weekly veterinary treatment. Here there was a 42% increase in milk yield. Even greater yields were obtained from similar camels with favourable food supplies such as Herd 1 which produced almost twice that of Herd 2.The effect of breed on yield is perhaps best shown in Herd 4, in which were small Turkana animals and although constrained neither by food or disease nevertheless had the second lowest yield.

Comparison with other areas.

Although there are almost sixty records from ten countries of the total yield of camels' milk it is difficult to make comparisons. However, with certain assumptions it may be calculated that the average lactational yield for the dromedary is 2,586 ± 1880.39 litres. The average duration of lactation is 13.8 ± 2.37 months and so for a twelve month period on a proportional basis, the average yield is 2,249 litres or 6.2 litres per day.

This places the yields recorded for Kenya in perspective, with the poorest (Herd 2) being little more than a third of the World's average. However, there is reason to believe that the latter figure is artificially high as authors, trying to promote the camel, have ommitted the poorer yielding animals as unworthy of mention.

Nevertheless the 'heavy' Indian and Pakistan breeds show, on good nutrition, a very high milk yield which ranges from 6.9-35 litres per day or 2,484 to 12,775 litres per year. The latter, albeit under optimal conditions, sets a target for the improvement of indigenous, traditionally managed, Rendille camels which is 16 times greater than their present productivity. To this end, Mr. Evans of Ol Maisor ranch, is currently visiting Pakistan in the hope of purchasing and introducing to Kenya young bull camels of this very productive breed.

Meat Production.

The growth of camels has been monitored in the same five herds (Field, 1979; Schwartz et al. 1982, Field et al. 1983). In addition, data on three hundred indigenous, traditionally raised Rendille, Gabbra and Turkana camel calves are available. Calves in Herd 1 were permitted to suckle throughout the day and were separated only at night. Results of these measurements are presented in the following table. (Table 11)

Table 11 Growth Rates of Camels in Grams/Per Day

Time Period	Herd 1 Range F	Herd 1 Range M	Herd 2 F	Herd 2 M	Herd 3 F	Herd 3 M	Herd 4 F	Herd 4 M	Herd 5 F	Herd 5 M	Indigenous camels Wet Range		Dry Range	
Birth to 6m.	371	638	197	259	313	351	555	611	650	678	270	310	170	206
6 to 12m	520	530	82	175	261	234	139	194	500	389	90	315	-	-
12 to 24m.	202	330	93	66	180	161	444	444	444	666	50	-	-	-
Birth to 12m.	405	425	210	170	240	260	342	397	603	562	-	-	-	-
Birth to 48m.	-	-	106	+96	149	+70	25	3	26	2	-	-	-	-
Birth to 60m.	-	-	15	1	-	-	21	6	24	5	-	-	-	-

Several points are illustrated by this table.

1. Growth rates at any stage were slowest in indigenous Rendille camels and least of all during dry years.

2. In the first six months after birth these camels grew at less than half the rate of Somali camels on Galana ranch.

3. Suckling throughout the day in Herd 1 appeared to increase growth rates by 187-265% when compared with indigenous calves, until 12 to 18 months.

4. Veterinary input increased growth rates in camel calves

in Herd 3 by 14-53% at one year of age and 41% at four years of age. The latter is evidence that veterinary input is increasing growth rate irrespective of milk yield.

In summary, breed, competition for milk with the owner and disease all have a limiting effect on Rendille camels.

Table 12 Weights of Adult Camels in Kg.

Herd	1	2	4	5
Breed	Somali	Rendille	Rendille	Rendille	Somali
Asymptotic Weight	650	500	400	460	590
Age at which asymptotic weight is reached, in years	-	8	9	5	6
Maximum weight recorded, in Kg.	720	550	525	540	700

The slow growth rate and stunting effect of traditional management on Rendille camels is again apparent.

The effect of breed on liveweight is also noticeable, with Somali camels being approximately one third heavier than Rendille camels. This also emerges from average calf birth weights, where Somali camels in Herd 5 were 42.8 Kg., Rendille camels in Herd 1 were 30.9 Kg. in Herd 3 were 29 kg and in Herd 2 only 25.8 kg. The former were therefore 66% heavier than the latter.

Herd Dynamics

Of vital importance to a pastoral camel herdsmen, in both the short and the long term, are the dynamics of his herd, that is whether it is increasing or decreasing and what are the causes of the changes.

Peaks of calving may lead to a super-abundance of milk in the household. However, this may be followed by times of severe shortage due to high calf mortality in drought, in particular between the ages of two and six months. Usually however, camels will continue to lactate, albeit at

a reduced level, provided the skin of the calf is present to provide the necessary stimulus for the milk let-down reflex. Another problem may be faced by pastoralists when the majority, or pe rhaps, all of his females are mated and conceive during the same rainy season. This will mean that they will commence to dry off about three months later. Fortunately in equatorial countries such as Kenya there is bimodal rainfall and correspondingly bimodal breeding and calving peaks in camels. This means that usually among the pastoral herds there are some individual camels calving in each of the wet seasons and this reduces the risk of the household facing a period with no milk at all. In more northerly latitudes however, such as northern Sudan, rainfall is unimodal and pastoralists may face such periods of milk shortage. This further underscores the need for supplementary stored food such as grain products in such areas and may explain on the contrary why pure pastoralism without cultivation is able to persist in northern Kenya.

The following three tables summarize the herd data.

Table 13 The Fertility of Camel Herds.

	HERD				
	1	2	3	4	5
Age at first calving (in months)	61	58	-	-	51
Calving interval (in months)	18.7	26.8	20.8	22.2	20.1
Calving percentage	45.0	21.1	47.4	54.0	53.0
Abortions (%)	0.0	26.0	3.2	00.0	5.3
Premature births (%)	12.0	6.0	1.6	-	3.5
Live births (%)	88.0	58.0	90.3	100.0	91.2
failed conceptions (%)	0.0	10.0	4.8	0.0	0.0

Table 14 Mortality Within Camel Herds

	Herd 1	2	3	4	5	Survey of Rendille
Calf mortality <1 year (%)	12.0	62.1	5.4	0.0	24.2	43-46
Calf predation (%)	0.0	0.0	1.8	0.0	4.0	3.1
Calf disease (%)	12.0	62.1	3.6	0.0	20.2	37.2
Immature deaths (%)	9.5	6.6	4.0	-	6.9	9.2
Adult deaths (%)	4.8	36.7	24.0	-	9.5	8.7

Table 15 Herd Dynamics

	Herd 1	2	3	5
Number at start	12	60	60	63
Number at finish	21	58	104	189
Change	+9	-2	+44	+126
% Change	+75	-3.3	+73.3	+200
Period in years	4	2.8	2.8	7
% Change per annum	18.8	-1.2	+26.2	28.6

The fertility data shows that Rendille camels first calve at about five years while Somali camels under good conditions may calve up to nine months earlier. This may result from faster growth rates due to better nutritional conditions at Galana ranch.

The mean interval between calves varies from 19 to 27 months. The former is near the lower limit and may only be expected under conditions of good nutrition. The latter is the situation in traditional herds where abortions are relatively common.

The effect of veterinary input on fertility can be seen by comparing Herd 2 under traditional management with Herd 3 which had veterinary care. The latter showed an increase in calving by 26.3% and reductions in calving interval by 6 months, and in abortions, due largely to the control of trypanosomiasis, by 25.5% and in premature births of 5%. This gave an overall increase in successful births of 30.5%

The mortality data shows that it is possible with good management to raise all calves through their first year. However, this requires the provision of an adequate supply of milk for a healthy calf and prompt action should diseases occur. By contrast, losses may exceed 50% in traditionally managed herds and this may be entirely due to disease. The role of predation is relatively unimportant in calf mortality. Among the main diseases affecting young calves are mange and ticks. The former is predisposed by malnutrition and both may be treated effectively with acaricides. The problem is now a matter of education through extension and of simple logistics.

The Contribution of Camels to Households Food Requirements.

Given that an average family of pastoralists requires from 15,000 - 18,300 Kcal of energy per day and that a litre of camels milk contains 700 Kcal of energy. Then the family has a daily requirement of 21 to 26 litres of milk assuming that it has no other source of energy. Similarly if 1 litre of milk contains 39 grams of protein and daily household requirements are 422 grams of protein then 10.8 litres of milk are required for protein needs.

Since an average Rendille household has 3.3 lactating camels at any one time, these animals under different management regimes may be expected to contribute the following proportions to the energy and protein requirements of the household.

Table 16 The Proportion of the Diet of a Rendille Household Supplied By Camels Milk

	Herd				
	1	2	3	4	5
% of required energy	26-32	14-17	19-24	18-22	33-44
% of required protein	62	33	47	43	81

From another point of view, we may calculate the minimum herd size of camels required to provide the household needs assuming that no other livestock are kept. As before, it assumes that half the camels are lactating and female camels comprise 55% of the total herd.

Table 17 Minimum Camel Herd Size to Provide Energy and Protein Needs

Herd	1	2	3	4	5
For energy needs	38-46	70-86	50-62	56-68	30-36
For protein needs	20	36	26	28	14

Several strategies present themselves to camel pastoralists.

Firstly, he may continue along the present lines, but there are indications that the growth of human and livestock populations cannot be sustained without some major management intervention. The productivity of his herds is likely to decrease as the rangeland further deteriorates.

Secondly, he may try to increase his herd to compensate for declining individual productivity. As we have seen, under the prevailing conditions, this should be strongly discouraged as it would necessitate a 6-7 fold increase in numbers to fulfill the energy demand.

This would be self defeating as the rangeland would not be able to sustain such an increase and would lead to an overall decline in productivity.

Thirdly, the camel pastoralist may seek to improve the productivity of his existing herds. Three possibilities have been demonstrated in other herds namely improved nutrition, minimizing disease and introduction of new breeds. This has the potential also of increasing the herd size so here care should be exercised not to exceed the carrying capacity of the range.

The last strategy involves the husbandry of mixed livestock and the use of energy rich food to supplement the diet of the family and thereby reduce the dependence on milk as a source of energy during seasons of limited supply. These last two strategies in combination offer the most promising possibilities to the camel pastoralist.

As we have seen, almost all camel pastoralists keep some other category of livestock in addition to the camel. In the case of the Ariaal

who fall between the Rendille and Samburu in culture they often keep both smallstock and cattle although this has a high demand on labour. Many Rendille rely just on smallstock to supplement their camel productivity.

It is now necessary to reconstitute the expected diet of a Rendille household based on observed stock holding and the productivity of IPAL owned flocks under traditional management and with a health program (i.e. improved management).

Sheep and goats

Under the two management regimes, the following average daily yields have been estimated per animal.

Milk.

Table 18 Milk Yields for Sheep and Goats in CC Per Day

Management	Sheep	Goats
Traditional	17.5	35.1
Health Program	17.5	39.2

The protein and calorific values vary between the two species as follows

Table 19 Protein and Calorific Values

	Sheep	Goats
Kcal Energy Kg^{-1} milk	1,114	700
Grams protein Kg^{-1} milk	63	36

These values are used in Table 20 to calculate the energy and protein yields per day.

Table 20 Daily Energy and Protein Yields From Smallstock Milk.

	Sheep		Goats	
Management	Energy (Kcal)	Protein (gm)	Energy (Kcal)	Protein (gm)
Traditional	19.5	1.1	24.6	1.26
Health Program	19.5	1.1	27.4	1.41

Meat

The following carcass growth rates were also recorded:

Table 21 Meat Yields from Smallstock in Grams per day.

Management	Sheep	Goats
Traditional	23	20
Health Program	27	24

With an energy value of 23600 Kcal and a protein value of 1.45Kg per 10 Kg of carcass, then the energy and protein available can also be calculated as follows table 22.

Table 22

Management	Sheep		Goats	
	Energy (Kcal)	Protein (gm.)	Energy (Kcal)	Protein (gms)
Traditional	54	3.3	47	2.9
Health Program	64	3.9	57	3.5

The normal ratio of sheep to goats in Rendille flocks is 1:1.5 Therefore household ownership of goats varies from 40 to 61 depending on whether data are used from table 5 or 6 and the sheep vary from 27 to 40.

According to a recent survey of smallstock flock compositions 40% of both species are adult females while the remainder can be considered as meat producers. Thus the protein and energy yield of a flock of smallstock numbering 101 animals of which 24 goats and 16 sheep are milk producers and 37 goats and 24 sheep are meat producers is as follows:

Table 2

	Sheep		Goats	
Management	Energy (Kcal)	Protein (gm)	Energy(kcal)	Protein(gm)
Traditional meat	1296	79.2	1,739	107.3
" milk	312	17.6	590	30.2
Total	1,608	96.8	2,329	137.5
Health Program meat	1,536	93.6	2,109	129.5
" " milk	312	17.6	658	38.8
Total	1848	111.2	2767	163.3

N.B. These figures would be reduced by one third for the smaller flock size.

Thus smallstock may supply from 22 to 26% of energy requirements and 55% of protein requirements of an average household. Under the health program these proportions increase to 25-31% for energy and 65% for protein.

Cattle

Simultaneous records have also been made on two herds of cattle under desert conditions. One received a health program while the other was managed on traditional lines. Twenty nine lactating cattle were monitored over a period of 22 months. Average daily yield of milk per cow for human use for all cattle whether in milk or not, was 335cc for the traditional herd and 371 cc for the herd with the health program. If we take the calorific value of cow's milk to be 700 Kcal per litre and the protein content to be 3.5% then the corresponding values are 235 Kcal and 11.7 grams protein for traditional animalsand 260 Kcal and 13 grams protein for a cow under the health program.

In the average household there are between 11 and 15 head of cattle. Of these 36% are adult females equivalent to 4 to 5.4 animals in the typical household. Thus cows milk may contribute the following amounts to the home diet.

Table 24

Number of cows	4		5.4	
	Energy (Kcal)	Protein (gms)	Energy (Kcal)	Protein (gm.)
Traditional herd	940	46.8	1269	63.2
Health Program herd	1040m	52.0	1404	70.2

Meat Production

Data on meat production pertain to calves only at the present moment. They show no significant difference between calves receiving the health program and those under traditional management, with mean daily weight gains being 170 grams and 179 grams respectively. If we assume that 64% of the herd are contributing, then the number per household is equivalent to 7 to 9.6 animals. Furthermore, using the same calorific values for meat as mentioned for smallstock and a 50% carcass, the herd can yield the following nutrients towards the daily household budget.

Table 25

Number of Cattle	7		9.6	
	Energy (Kcal)	Protein (gm)	Energ (Kcal)	Protein (gm.)
Traditional herd	1,478	90.8	2,028	124.6
Health Program herd	1,404	86.3	1,926	118.3

The combined contribution of milk and meat from cattle would be as follows.

Table 26

Number of cattle	11		15	
	Energy (Kcal)	Protein(gm)	Energy(Kcal)	Protein (gm.)
Traditional herd	2418	137.6	329.7	187.8
Health Program herd	2444	138.3	3330	188.5

There is no significant difference between the treatments.

From this we conclude that cattle may contribute from 13 to 22% of energy needs and from 33 to 45% of protein needs of the household.

We are now in a position to summarise the information from the different categories of livestock and the different treatments for livestock under traditional management. Daily yields are as follows:

Table 27

	Camels	Cattle	Smallstock
Average number owned	12	11	101
Energy from milk (Kcal)	2550	940	902
" " meat (Kcal)	1351	1478	3035
% of required minimum	26	16	26
% of required maximum	21	13	21
Protein from milk (gm)	142	47	48
Protein from meat (gm)	83	91	187
% of required diet	53	33	56

From the table it is clear that under traditional management there is adequate protein available from flocks but that there is a shortfall in energy requirements by about 31%.

Under a health program the following daily yields are obtainable.

Table 28.

	Camels	Cattle	Smallstock
Average number owned	12	11	101
Energy from milk (Kcal)	3,581	1040	970
" " meat "	1899	1404	3645
% of required minimum	36	16	31
" " " maximum	30	13	25
Protein from milk (gm)	200	52	51
" " meat (gm)	117	86	223
% of required diet	75	33	65

From these tables it can be seen that whereas the household herds are more than adequate for protein requirements they fall well short of supplying energy needs. Even under a health program, there is still a shortfall of 17% in energy.

Although we have included a contribution from camel meat in these calculations it is perhaps premature as they are rarely slaughtered. Also our management recommendations encourage building up camel herds since they are the least destructive, best adapted and most productive of the livestock categories. Furthermore additional males are required for a transport cadre which will enable livestock to reach and utilize the remotest parts of the range on a rotational basis.

The important position of the camel as a food producer for the pastoralist is illustrated in these tables. Cattle,by constrast, contribute substantially less, they damage their environment in the process and there is little hope for their improvement.

Smallstock have an important function, in particular as a source of meat in dry seasons. Their milk contributes little to the diet. Smallstock are also a convenient size for minor trade negotiations and for social obligations. By selling a castrated goat or sheep a pastoralist can obtain 150 Kshs. with which to purchase 40 Kg of maize meal or 20 Kg of sugar. These energy rich sources of food go a long way to filling the shortfall in energy in the diet and they lift the reliance of the pastoralist on milk in an environment which is hostile for milk production.

Management Policy to Optimize Camel Productivity

Detailed management recommendation for livestock in Western Marsabit have already been published in UNESCO-IPAL (1983).

It is clear from the data so far presented that livestock are producing well below their maximum potential and there is considerable room for improvement.

The three main interventions involve improvements in the spheres of (1) Nutrition (2) Disease control (3) Genetic resource base .

In summary these involve the following management procedures.

(1) Nutrition.

a) The introduction of a prescribed rotational grazing program such that stocking rates remain within the carrying capacity of the range.

b) Collection and supply of supplementary feed in the form of Acacia tortilis pods which will be available at critical times of the year.

c) Through education and extension encourage a more equitable balance in the sharing of milk between the pastoralist and the camel calf.

(2) Disease Control.

Special emphasis will be placed on the control of camel diseases through the veterinary clinics and extension workers already active in the area. The control of the following diseases is of major importance.

a) Trypanosomiasis

b) Helminthiasis

c) Ticks and mange

3) Genetic Resource Base

The introduction of more productive camels is recommended. Finally, camels of the adjacent Somali breed are preferred, but other breeds such as those from Pakistan should be considered at a later date if they prove adaptable to the conditions prevailing in Kenya.

Conclusions

In what is probably the first and only simultaneous survey of the productivity of all major livestock categories in a part of the arid zone of Africa, we conclude that the camel is the most important source of food for the pastoral households while smallstock run a close second.

While the pastoral herds are more than adequate to supply protein needs, they fall short in their supply of energy. This is obtained through the sale of smallstock with which to purchase energy rich cereals and sugar. Occasionally blood also supplements this need.

The introduction of a health program for smallstock and camels will probably increase the energy intake of households by about 12%. Improved nutrition and more productive breeds may provide the remaining 17%

Management recommendations are outlined and the Key role of the camel is stressed insofar as it is well adapted to the arid zone and is therefore unlikely to damage its environment excessively should a health program lift the existing constraints to population growth.

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FORAGING BEHAVIOUR AND THE APPARENT DIGESTION STRATEGY BY THE CAMEL-STUDIES UNDERTAKEN IN IPAL STUDY AREA

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Introduction

The one-humped camel, Camelus dromedarius, kept by the Rendille is relatively a smaller animal than the Somali type. It is kept mainly for subsistence production of milk, meat and occasionally blood. Its use also as a transport animal for water, firewood, and moving manyattas contributes significantly to the camel's importance.

The camel, generally, is a hardy animal capable of utilizing poor quality forages to convert into milk and meat etc. Long watering intervals gives it an added advantage over other livestock species in the semi-arid zone. Relationship between the poor quality forage utilization by the camel and the digestive physiology and anatomy seems to exist and should be clearly understood. The camel's body temperature rises several degrees during the day and falls slowly during the night and it uses the sweat glands economically Mukasa-Mugerwa (1981). Besides, the camel has a physiological adaptation to the semi-arid and arid environments by having varying body temperature according to the ambient temperature; thus enabling it to graze for longer hours during the day unlike cattle, sheep and goats whose grazing activity is minimal between eleven and three o'clock. Other remarkable characteristics are thick and split upper lips for easy selection of forages; urea-nitrogen recycling and water conservation by means of urine concentration.

Currently, there exists increasing amounts of literature on food habits of the camel but not much has been reported on the species preferences and the nutritional nature of the forages for the camel. This paper will therefore attempt to report on plant species preference and its corresponding nutrient content; and the relationship between the nature of camel's diet and the physio-anatomical adaptation of the digestive tract. Possible multi-specific herd management strategies in the arid-zone will be discussed in the light of the foraging behaviour of the camel. This

information is part of the livestock nutrition experiments undertaken by the project which involved detailed studies on diet preference, dry matter intake rates and the nutritive quality of forages in the rangeland.

Study area

The IPAL study area has been described in many technical reports published by the project (Lusigi 1981, 1983). It covers an area of 22,500 km^2 in the South-Western Marsabit District of Northern Kenya. The rainfall is unreliable, both in time and space. The vegetation cover is therefore very varied. There are small mountain forests at the peak of the mountains and perennial grasslands on lower slopes of the mountains. In the lowlands one finds ground-water forests, semi-deciduous woodlands, semi-arid to arid bushlands and shrublands, arid dwarf shrublands, annual grasslands and barren lands. Apart from the mountains, which received about 700 mm average rainfall, the rest of the area receives about 200 mm annual average. The area is inhabited by nomadic and semi-nomadic tribes which include the Rendille, Samburu and Gabbra. The major livestock species are camels, sheep, goats and cattle, from which the nomads derive their livelihood.

- Methods used for the foraging behaviour studies.

Observation during total fecal collection trials

Some of the records on the feed habits of the camel were taken concurrently during total fecal collection studies where a camel was followed throughout the day (also at night) and the feces voided were collected for dry matter intake calculation. Plant species eaten by the camel was recorded.

Feeding seconds observation technique

"The feeding seconds" observation technique involved observing twelve camels, separately for a period of ten minutes each. The amount of time spent feeding on a particular plant species was also recorded. The total feeding time in seconds, spent by the 10 camels in each plant species was then summarized and expressed as a percentage of the total time. Also recorded was the part of the plant consumed by the camel. The mean percentage time spent by camels on each plant species during the experimental period was calculated and used as a scale for plant preference. The plant species which made 80% of the diet were handclipped and processed for chemical analysis and digestibility determination.

Observations during Oesophageal fistula sample collections for diet preference determination

Oesophageal fistula samples were collected from oesophageal fistulated animals fortnightly using screen-bottomed collection bags to allow drainage of excess saliva. One hour collection period was allowed for camels, during which period they were followed and the plant species and plant part bitten was recorded. Fistula samples (extrusa) were separated by hand-sorting into different forage species and each species weighed (fresh and air-dry weight recorded). Finally, the air-dry separated forage species from each animal for single collection was bulked and mixed thoroughly before sending for chemical analysis, in vitro and nylon-bag digestibility of dry matter.

Diet composition from the Oesophageal fistula sample collection method

The diet of camels was found to be made mainly of trees and large shrubs, dwarf shrubs ,with very little herbs and grasses. (Table 1.) The camel is endowed with a long neck which enables it to browse at 3.5 m above ground, thus they only compete with giraffe for browse. This fact alone shows that multi-species herd management is advantageous as all the riches in the grazing area is efficiently utilized. In the area around Ngurunit, which is an Acacia woodland type of vegetation, the following diet composition was found: 35.2% trees and large shrubs- 62.7% dwarf shrubs, 0.4% herbs and 0.7% grasses, as determined from oesophageal fistula sample separation. In an adjacent area, of Indigofera/Heliotropium with Acacia dwarf shrubland, the diet composition was as found to consist of 31.3% trees and large shrubs, 64.6% dwarf shrubs, none of the herbs and 4.1% grasses. Although the camels preferred trees and large shrubs; and dwarf shrubs than the herbs and grasses, the diet composition would shift according to the availability of the four classes of forages and season. From these oesophageal fistula samples there were individual plant species which contributed significantly to these diets. Cadaba farinosa, Terrena graveoleus, "Lpukenyi", Maerua crassifolia and Commiphora paolii made 12.3%, 8.8%, 6.7%, 2.2%, 2.2% of the diet respectively,within the trees and large shrubs class. The dwarf shrubs class was dominated by the species Duosperma eremophilum (11.5%). Newman (1979) reports the morphology of the dromedary and the unique dexterity of its mouth enables it to selectively browse upper-storey plant material, but despite these specilized capabilities, it is equally well equipped to graze understorey, plant communities, and employs a vacuum-like technique in virtually

"sucking-up" feed. He also reports comparable results with those reported here on the diet composition of the Australian dromedaries which comprised 70% shrubs and forbs in winter, increasing to 90% during summer.

"Feeding seconds" observation method results

The percentage composition of the diets of camels as determined by the "feeding seconds" observation method are comparable to those from the Oesophageal fistula samples and are presented in table 2. Again the diet was dominated by the trees and large shrubs and dwarf shrubs with little contribution from grasses. The major contributions to the diet were Indigofera spinosa, Indigofera cliffordiana, Duosperma eremophilum, Maerua crassifolia, Cordia senensis, Cadaba farinosa, Premna racemosa, Sericocomopsis hildebrandtii, Cordia gharaf, Grass litter and Balanites aegyptiaea. It is important to note that these forages only made 80% of the camel's diet and the respective individual plant species contribution are indicated in table 2.

Because the diet of camels is made of trees and large shrubs, dwarf shrubs with little grass and herbs, this has important vegetation degradation implications by the camel. Unlike trees and shrubs communities the grasses are stimulated to grow upon being grazed. In the long term, trees and shrub material may require a longer regeneration period after being eaten than is the case with grasses, and as these species are regarded as being more susceptible to death from overgrazing (Warren and Maizels, 1977), the foraging habits of the camel may contribute to the degradation of the forage. However, this phenomenon may be compensated for by the intensity of grazing habits of the camel. Gaulthier-Pilters (1979) observed that the camel's way of feeding represents the most rational utilization of semi-arid and arid vegetation. The camel normally moves constantly through the range eating small portions of each plant species and hardly concentrating on one plant. The mobility of the camel also makes it not possible for one herdsman to herd both camels and sheep, cattle or goats where labour requirement is critical. In the UNESCO-IPAL study area camels, sheep, goats and cattle are kept almost in the same locality by the Rendille pastoralists. Although these livestock species are grazed separately, they cover these same grazing localities. It is important to note, that there is significant dietary overlap between camels and goats and between sheep and cattle (Tubei, 1983) which may indicate competition between these animal species. Except around watering points and closer to the homesteads, direct competition for forage

between the livestock species may not be acute during the wet season when feed availability is good, as the animals are normally let out to graze in different localities. The presence of these animal species - grazing in the same range is advantageous because of the efficient use of grazing resource by utilizing all the vegetation categories. However, during the dry season, the situation is different as feed availability is limited and the dietary overlap increases and the animals may compete for feed. However, Merrill et al (1966) showed that grazing two or more kinds of livestock on mixed vegetation (edible shrubs, grasses and forbs) had two main benefits. First, more and different vegetation was grazed, which equalized the grazing load. Second, each animal benefits from the grazing by the two other kinds, provided the stocking rate is not too high. These benefits relate to the action of the larger animal breaking down edible browse, stripping less palatable plant parts and through area selective grazing within pasture.

Table 1. Percent botanical composition by weight in the diets of camels, in acacia woodland range.

	Camels	% Availability*	Parts of plant consumed
Trees and Large Shrubs			
Acacia senegal	<0.1	NA	young twigs and leaves
Acacia tortilis leaves	0.3	NA	leaves and twigs
Acacia tortilis pods	-	NA	pods (fallen)
Boscia coriacea	<0.1	NA	leaves
Cadaba forinosa	12.3	NA	leaves and tips of twigs
Commiphora boiviniana	-	NA	succulent twigs + leaves
Commiphora paolii	2.2	NA	leaves and buds
Commiphora ply	0.2	NA	leaves and buds
Cordia sinensis	<0.1	NA	leaves, twigs and fruits
Euphoribia cuneata	0.1	NA	twigs with leaves
Grewia bicolor	<0.1	NA	leaves
Grewia tenax	1.6	NA	leaves, few twigs
Grewia villosa	-	NA	leaves and twigs
"Lpukenyi"	6.7	NA	young shoots, and leaves
Naerua crassifolia	2.2	NA	leaves and twigs
Psychotria kirkii	0.1	NA	shoots and leaves
Salvadora persica	0.3	NA	twigs and leaves
Terminalia orbicularis	0.1	NA	leaves
Terrena graveslens	8.8	NA	leaves + few shoots
TOTAL	35.2	18.7	

Table 1 (continued)

	Camels	% Availability*	Parts of plant consumed
Dwarf Shrubs			
Barleria prilonites	0.5	2.3	leaves, flowers, stem
Barleria proxima	1.4	2.0	leaves, flowers, stem
Duosperma aremophilum	46.0	21.1	leaves and buds
Heliotropium sp.	-	2.0	leaves + bit of stem
Hibiscus micranthus	-	4.3	young twigs and leaves
Indigofera cliffordiana	11.5	5.4	tops of plant
Indigofera spinosa	0.5	1.9	tops of plant
Kedrostis gijef	2.6	0.9	whole plant
Sericocomopsis hildebrandtii	0.1	T	leaves
Ocimum sp.	-	0.03	flowers and leaves
Veronia sp.	0.1	0.8	whole plant
TOTAL	62,7	40.7	
Herbs			
Abutilon fagrianum	0.1	0.8	leaves, few shoots
Crossandra nilotica	-	0.1	leaves and growing points
Cucumis sp.	0.2	0.1	leaves fruits
Pupalia lappacea	0.1	0.3	whole plant
TOTAL	0.4	1.3	
Grasses			
Aristida adscensionis	0.7	1.2	whole plant
Aristida mutabilis	-	1.2	whole plant
Cenchrus ciliaris	-	0.3	whole plant
Digitaria velutera	-	10.8	whole plant
Choris irigata	-	2.3	whole plant
Sporobolus fimbriatus	-	2.6	whole plant
Tetrapogon sp.	-	0.09	whole plant
Grass litter	-	9.7	
Bracharia leersioides	-	0.4	whole plant
TOTAL	0.7	28.6	
Unidentified	-		
TOTAL	100	89.3	

Table 2: Dietary composition of the camel from the "Feeding seconds" observation method

Plant species	Percent contribution to the diet of camels	P
Indigofera spinosa	15.0	1
Indigofera cliffordiana	14.5	2
Duosperma eremophilum	14.5	3
Maerua crassifolia	9.8	4
Cordia sinensis	5.2	5
Cadaba farinosa	3.5	6
Prema racemosa	3.2	7
Sericocomopsis hildebrandii	2.9	8
Cordia gharaf	2.6	9
Grass litter	2.5	10
Balanites aegyptiaea	1.9	11
Heliotropium steudrieri	1.5	12
Justicia sp	1.2	13
Kedrostis gijef	0.9	14
Grewia tenax	0.8	15

Relationship between camels' diet composition with respect to chemical composition and digestive physiology

The chemical composition of the forage species which made a great proportion of camels diet were analysed and are presented in table 3. Analysis for Crude Protein (CP), Neutral Detergent Fibre, (NDF), Acid Detergent Fibre (ADF), Acid Detergent Lignin (ADL) and Calcium (Ca) and phosphorus was done on the hand-clipped samples and oesophageal fistula samples. Most of the trees, shrubs and herbs contained high level of CP (>12.0%). Only Blepharis linariifolia and Commiphora spp. had low CP in this vegetation group. The grasses generally had low levels of CP which ranged from 7.1% to 14.2%. NDF was generally lower in the trees and large shrubs; dwarf shrubs and herbs (NDF ranged from 21.2% - 57.1%) than in the grasses (with a range of 60.5% to 75.1% NDF). The lignin content was also found to be high. Calcium (Ca) content was higher in the trees, shrubs and herbs than in grasses while phosphorus (P) was relatively the same for both groups. Similarly the NDF content of the oesophageal fistula samples was lower (57.6%) on average. Average Crude Protein was 21.2%. In vitro digestibility of dry matter (IVDMD) was relatively low for the fistula samples and also for the hand-clipped samples.

From the results above, there are notable observation with respect to the camels diet and the digestion of that diet. The camels' diet was made of trees and large shrubs with little herbs and grasses which were found to be high in neutral detergent fibre or cell wall contents, when analysed chemically. This information has been reported in other studies but it has some relationship with the digestion by the camel. Because the cell wall contents are low, it follows then that the cell contents, which are more digestible, are high.

Forages with a low cell wall content typically have more rapid rates of rumen fermentation (Smith et al. 1972, Shorter et al. 1974) and those with a high cell wall content. Leaves of forbs and shrubs typically have lower cell wall contents than grass leaves and stems at comparable stage of maturity (Shorter et al. 1974, Huston et al. 1981). Also Van Soest (1965, 1966 and Tubei 1981) reported that forages with high lignin contents tend to have low cell wall contents than those of low lignin contents. In this case the trees and shrubs have higher lignin contents than the grasses. The higher lignin content of forb and shrubs leaves and stems compared to grass leaves and stems may increase the rate of passage

Table 3: Chemical composition and digestibility of forages
(mean of each component in hand-clipped samples for each plant species is indicated)

Forage Species	CP%	NDF%	ADF%	ADL%	Ash%	Ca%	P%	IVDMD%	No.of samples analysed
Trees and Large Shrubs									
Acacia reficiens	18.3	45.4	17.0	8.1	-	3.2	0.1	37.2	2
Acacia senegal	18.8	30.2	-	9.6	10.5	3.3	0.2	38.6	1
Acacia tortilis	18.9	45.2	29.6	12.7	0.8	2.4	0.2	33.2	9
Balanites aegyptiaum	20.2	41.8	27.0	9.0	-	-	-	42.9	1
Cadaba farinosa	22.7	57.1	40.3	15.3	0.1	-	-	29.4	1
Cadaba ruspolii	17.2	38.1	22.4	12.6	1.8	4.1	0.04	36.9	1
Combretum aculeatum	22.7	32.0	25.1	5.0	0.9	2.3	0.18	43.8	5
Cordia sinensis	15.7	50.0	38.4	23.6	5.3	3.3	0.18	23.8	8
Commiphora boiviniana	18.3	45.4	32.4	13.2	2.8	-	-	34.6	2
Commiphora canoidula	7.7	40.5	31.6	9.1	8.4	-	-	51.4	2
Commiphora flaviflora	8.3	28.4	27.0	4.9	-	-	-	27.4	1
Commiphora paolii	13.2	30.8	-	-	-	-	-	-	1
Grewia tenax	16.2	48.7	24.2	5.2	0.4	4.4	0.19	48.1	6
Lawsonia inermis	12.0	26.7	20.8	5.0	0.6	2.6	0.20	34.4	6
Maerva crassifolia	22.3	36.6	26.4	7.9	0.1	3.0	0.11	46.0	4
Psychotria kirkii	13.3	23.6	20.3	6.3	0.3	3.5	0.17	-	2
Sterculia africana	13.8	45.9	32.3	10.2	3.8	-	-	39.6	2
Terrena graveolens	21.7	28.7	23.6	6.6	0.2	2.9	0.3	56.8	4
Dwarf shrubs									
Barleria sp.	16.1	50.7	41.9	11.0	0.8	3.20	0.34	34.6	3
Indigofera cliffordiana	13.6	59.4	46.4	11.9	0.7	5.6	0.17	30.1	10
Indigofera spinosa	12.8	62.2	49.7	11.3	0.5	2.9	0.27	31.9	11
Duosperma eremophilum	15.3	35.2	24.6	6.3	1.9	7.6	0.25	43.1	25
Sericocomopsis hildebrandtii	15.2	44.1	24.9	4.5	6.8	4.7	0.59	39.7	3
Heliotropium sp.	16.3	58.3	39.5	12.5	0.9	7.7	0.3	41.8	4
Kedrostis gijef	17.4	21.2	18.5	7.1	1.6	7.1	0.27	30.2	3
Vernonia sp.	18.8	42.6	32.8	9.6	2.3	2.5	0.24	42.9	2
Herbs									
Olepharis linerrifolia	9.1	-	40.7	11.5	2.9	1.6	0.10	-	1
Commelina blughalensis	22.8	46.7	38.4	6.1	1.5	3.7	0.29	47.0	4
Ipomea sp.	20.4	35.5	23.9	6.9	1.6	1.4	0.3	49.3	6
Abutalon fagirianum	17.4	42.4	26.1	7.2	0.3	1.8	0.15	41.9	1
Cucumis sp.	17.8	23.0	20.8	5.9	2.7	6.8	0.28	38.3	11

Table 3: (continued)

	CP%	NDF%	ADF%	ADL%	Ash%	Ca%	P%	IVDMD%	No. of Samples analysed
Grasses									
Aristide mutabilia	9.0	75.1	46.2	6.0	3.9	0.6	0.08	41.8	15
Eragrostis Silianensis	14.2	70.1	42.1	7.0	2.7	0.8	0.17	38.4	10
Brachiara iearsioides	12.1	61.2	37.3	4.9	3.6	0.8	0.24	43.3	11
Chloria virgata	7.1	72.7	43.5	5.6	1.4	0.7	0.21	44.3	1
Grass litter	9.1	63.8	41.5	9.4	6.0	-	0.14	32.4	4
Digitaria valuteria	11.9	60.5	34.5	8.0	4.0	0.6	0.28		

by making these parts more brittle and causing finer fragmentation (Milchunas et al. 1978). Finer particles pass more quickly out of the reticulo-rumen compared to the larger ones (Van Soest 1966, Mertens 1973).

It would therefore appear that the camel has a strategy of selecting for trees and shrubs which are high in lignin and low in cell wall contents. This will mean it forages rapidly, digests in the rumen within a short time and absorbs fast so as to meet its nutrient requirement. It is notable that high rate of passage is associated with high feed intake. Separate studies also report valuable results to support this strategy. Maloiy (1972) reported that fluid outflow from the forestomach and passage of feed through the gut was higher in the camel than in the Zebu steer and might have been the reason for the observed lower efficiency in camels in digesting dry matter of low quality hay. Other ruminants like cattle and sheep have a longer retention period of feed in the rumen where microbial action takes place. This argument is further supported by Engelhardt and Riibsamen (1979) who reports absorption rates of 2-3 times in the rumen of the camel than that of sheep and goats.

The camel may also be hosting different microbial populations in the rumen. For instance the camel was found to have protozoa, namely: Epidenium, Metadenium and Endiplodenium, which were absent in the rumen of sheep (Farid et al. 1979).

Crude Protein content could be a limiting nutrient in the forages forming the bulk of the camel's diet. However, possible addition of nitrogen as urea in saliva or acrosstthe rumen epitheliun and the wall of the lower GIT (Bailey and Balch, 1961; Sommers, 1961; Cosimano

and Leng, 1967; Houpt and Houpt 1968; Nolan and Leng, 1972) could be an added strategy of the camel to utilize low quality diets. Protein deficiencies in the diet can substantially reduce digestibility of feed and subsequently, the voluntary feed intake. This is particularly so if the crude protein content falls below 7.0%.

Conclusion

The camel is definitely an animal adapted to the arid and semi-arid regions but its impact on the grazing resource through foraging may be significant if they are introduced in an area where the vegetation is made -up of trees and shrubs or if overstocked. Its feeding habits, concentrating mainly on the trees and large shrubs, and dwarf shrubs which have longer regeneration periods, could be more damaging to the vegetation than sheep and cattle which feed on grasses mainly. The camel's digestion strategy of feeding rapidly, faster digestion and absorption means faster rate of passage through the gastro-intestinal tract and hence higher feed intake, is also in itself demanding more biomass than cattle of the same body weight.

However, plant community changes may also predispose more to trees and shrubs in certain localities thus making the camel a more efficient user of that kind of plant community. On the whole the digestion pattern of the camel is very strategic to its survival and has also been observed in wild animals like deer.

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PROSPECTS FOR IMPROVING THE MARKET FOR CAMELS FROM NORTHERN KENYA

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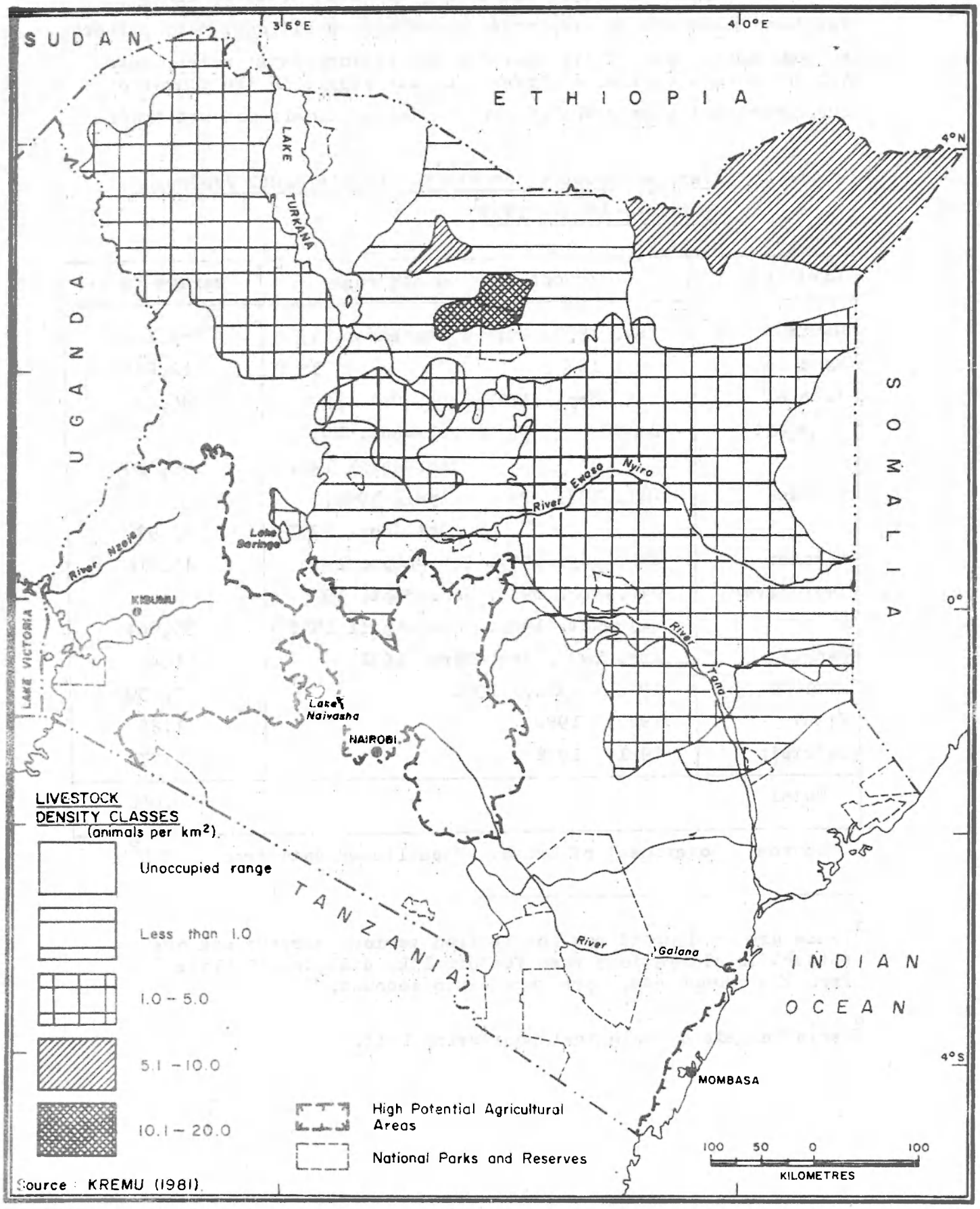
Introduction

In Kenya camels are kept by pastoral tribes living in very arid to semi-arid areas in the northern and north eastern parts of the country. These include the Somali, Gabbra, Boran, Rendille, Samburu, Turkana, Pokot and Galla (Bremaud, 1969). Map 1 below shows the density of camels in these regions. The highest densities (over 5 camels per sq. km^2) are in the Northern Somali, Gabbra and Rendille areas while the lowest concentrations are in the Turkana, Samburu and Galla areas. Table 1 which shows the distribution of camels on a district basis again reveals a similar trend.

Nomadic pastoralists migrate from place to place within their tribal territory in search of grazing and water. This is necessary because of the sporadic and unpredictable nature of rainfall both in time and space. Because of this need for movement, pastures traditionally belong to the community and are available for use by all its members' livestock. As most of the area is very dry, it is unsuitable for sustained agriculture except along river courses and on a few isolated areas on mountains which are wetter. As a result, few pastoral families have opportunities for engaging in agriculture and producing crops. Their main priority, therefore, is to feed their families from livestock.

Livestock can provide human food in the form of meat, milk or blood. Since provision of meat necessitates the killing of the animal, most nomadic pastoral people depend on milk and blood. The supply of these, over time, is more regular than that of meat because under arid conditions, livestock productivity is low and replacements for slaughtered animals may not be easily generated. Camel pastoralists are no different in this respect and use their camels chiefly for milk, and to a lesser extent,



KENYA LIVESTOCK DENSITY MAP

CAMELS

blood and meat. As camels are strong and able to carry loads for long distances in very arid, waterless conditions, they perform an additional task of transporting the pastoralists' water, huts and domestic utensils, children and sick people in the course of their movement across the range. In Kenya, camels are not tradi-

Table 1: Average Number of Camels in Kenya's Camel Producing Districts 1977 - 1983[1]

District	Periods when counts made.	Average Number
Wajir	Aug. 1977, July & September, 1978	159,485
Mandera	Aug. 1977, " 1978	112,225
Isiolo	Aug.-Sept. 1977, Aug.-Oct. 1978	96,680
Marsabit	Aug. 1977, July-Oct. 1978 Feb.-April 1981	89,810
Turkana	Oct. 1977, Feb. - April 1981, Oct.-Nov. 1983	75,992
Garissa	Feb.-Aug. 1977, Feb.-Sept. 1978	45,814
Tana River	Feb.-Aug. 1977, Jan.-Sept. 1978 July-Oct. 1980, March-April 1983	33,964
Samburu	Aug. 1977, Feb.-March 1981	11,458
Baringo	1977, 1981, 1982	1,630
Kitui	1977, 1980	1,267
Laikipia	1981, 1982	733
Total		628,050

Source: Government of Kenya: Unpublished data from KREMU[2]

[1] These are unadjusted raw counts from various surveys and are subject to alterations when factors like distance of place from the ground etc. are taken into account.

[2] Kenya Rangeland Ecological Monitoring Unit.

tionall used as riding animals by able bodied people

In the provision of milk, camels have an advantage over other animals kept in the region like smallstock (sheep and goats) and cattle. This is because they lactate for a whole year and produce more milk than cattle even in the driest of months when smallstock and cattle usually dry up (Anne Beaman, 1981). In the drier parts they are better than donkeys as beasts of burden: donkeys cannot carry heavy loads and because of their water needs must remain within one or two days walk from water. Camels on the other hand, can stay for upto ten days without water in the dry season and can go for up to two months without it if the vegetation is green and luscious.

Pastoralists' meat requirements are better met by smallstock which are almost universally kept by camel keepers. These provide meat in small quantities, easily consumable by one family before the meat goes bad. In these areas fresh meat gets spoilt in a few hours due to the excessive heat and lack of appropriate food preservation technology. In any case camels are not good meat producers. They reach their mature age after five to six years, mature weight after seven to eight years, and calve only once every two years. On the other hand smallstock reach maturity at one to two years and can even breed twice in a good year. Even cattle perform better as meat producers than camels because they reach mature age and weight in three to four years and can calve once every year or twice every three years. Cattle and smallstock are therefore better meat producers and where conditions permit pastoralists keep multispecies herds so that each species can supplement the other's weakness and provide more wholesome subsistence for the family.

As camels are not kept for meat they are only slaughtered on special ceremonial occasions or when due to an accident, sickness or old age they stand a risk of dying. In non-muslim areas most animals which die from disease or other causes are also eaten.

Camels as a Source of Cash

Most of Kenya's pastoralists who keep camels, keep them for the functions mentioned above and, rarely if at all, as a source of cash. This is partially because most of these communities

have not yet become commercial producers with most output finding its way to the final consumer through a market. They are still engaged in providing for most of their basic needs directly from their herds. All however participate in a small way in the market process where they obtain supplies of cereals, sugar, salt, medicine, clothes, ornaments, tools, etc. The fact that camels are rarely sold to raise the required money is more due to lack of markets for them than to a subsistence based society. This is true because other livestock,like cattle and smallstock for whom markets exist, are traded. Indeed,when markets offering good prices are available, as in the 1936 Italian - Ethiopian War, the number of camels sold was very large (Government of Kenya, 1938). Opportunities for the sale of camels are however restricted to the following:

a) Sales to other pastoralists who want to build their own camel herds.

b) Sales to local butchers for slaughter in major towns in camel producing areas.

c) Sales to local traders for onward transmission to other areas where demand for camels,for meat or other purposes,may be high.

Sales to other Pastoralists

In each pastoral community there are individuals with non-pastoral sources of income:from employment, petty trade, or remittances from friends and relatives. Frequently,they invest these monies in livestock, but more often in cattle and smallstock than in camels. This is partly because camels command much higher prices than cattle and smallstock. The small amounts of money available are usually not enough to buy a camel. The second reason is that a number of those who invest such monies want to see quick returns. Camels take time to increase in numbers or to mature if purchased young and are not popular for this reason. Finally,people wanting to invest in camels are interested in female stock while most pastoralists are only willing to sell surplus males and consider sale of female camels as careless expenditure of capital. If misfortune befalls a person who is known to have sold females, relatives are often

unwilling to give him gifts, as required by custom, because of the feeling that he squandered his capital.

Sales to Local Butchers

In the ma or trading centres in camel keeping areas, the demand for camel meat exists and as a result butchers buy camels for slaughter. The numbers involved are however small when compared to the number of cattle and smallstock which are also slaughtered by such butchers. This is especially so in Marsabit, Turkana, and Isiolo but less so in North Eastern Province where the number of camels slaughtered domestically is almost equal to local slaughter of cattle. The number of camels slaughtered in local butcheries are reported in district and provincial annual reports. It is small and unlikely to be more than 5,000 to 6,000 camels for the whole country.

Sales to Local Traders for Export

Annual reports from districts in camel keeping areas rarely show movement of more than a few camels out of any such districts. This is because unlike the trade in smallstock and cattle where a large number of animals are exported to supply the demand in the more populous central highlands and the coast, the markets for camels only exist in camel keeping areas. It seems that most are more than self-sufficient in their camel requirements and there is little legal inter-district movements of trade animals. Movements however do occur in search of grazing and it is possible that unrecorded illegal inter-district transfer of trade animals do occur. In Marsabit, where the author has some experience, Turkana camels are occasionally brought across the border by Samburu itinerant traders for exchange with smallstock without this being reported to the authorities. It is also widely suspected that up to 5,000 camels per annum are illegally exported from North Eastern Province into Somalia[3]. An unspecified number is also smuggled into Ethiopia and Sudan. This is possible because all these countries share some common borders and border crossings are difficult to monitor. They also have well established trade links with the Middle East countries and as a result the prices

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[3] Estimates made by S. Meadows former head of Kenya's Livestock Marketing Division in 1982.

of camels there are much higher than in Kenya. In 1983 for example, traders in Marsabit claimed that large camels were fetching about 5,000/- in Somalia while the local prices in Marsabit were between 1,500/- and 2,500/-.

Tables 2 and 3 below illustrates the points made above using 1982 figures for Marsabit and North Eastern Province.

Table 2: Local Sales, Slaughter, and Export of Livestock from North Eastern Province - 1982.

	Sales	Local inspected Slaughter	Exports
Cattle	5,812	3,816	11,821
Small stock	16,724	25,480	38,914
Camels	1,277	3,063	-

Source: Provincial Annual Report, 1982.

Table 3: Local Slaughter and Exports of Livestock from Marsabit District 1982.

	Sales	Local Inspected Slaughter	Exports
Cattle	N/A	2,001	615
Smallstock	N/A	6,227	21,886
Camels	N/A	72	

Source: District Annual Report, 1982.

These two areas contain most of Kenya's camels. No figures for Marsabit sales are given because there are no markets where such transactions can be recorded, as is done in the markets of Wajir, Garissa, and Mandera districts in North-Eastern Province. From the point of view of local inspected slaughter, Marsabit is more representative of other districts

where camels are kept.[4] North Eastern Province is unique in this respect because the Somalis who occupy it have more camels than cattle and are more commercialised than other camel pastoralists so that purchase of meat from butcheries is common. In other areas the habit of buying meat has not caught on and most slaughter for domestic consumption is done at home and thus goes unrecorded. This also means that there is little demand for camels by local butchers. Most of the meat buyers are urban dwelling civil servants and traders who often do not come from areas where camel meat is eaten. This is the case in Marsabit town, Maralal and Lodwar. At Isiolo, where a large number of Somalis and Boranas who are prepared to buy camels meat live, about 13 camels were being slaughtered every month in 1982.

Consequences of Lack of Markets

This lack of market outlets for camels has led to a situation where there is little that can be done to barren females, and males that are extra to pastoralists' breeding and baggage animal requirements, than to cull females and males other than eating them. It was noted earlier that pastoralists rarely slaughter their camels except onceremonial occasions or when they die or are about to die due to accidents disease or old age. Because of this, most pastoral camel herds contain quite a number of animals in the categories enumerated above. Once the barren females and surplus males have reached their maximum weights, keeping them for much longer represents waste of grazing, labour and other resources required for their upkeep. This also applies to culls. To the pastoralists, such animals represent a store of meat, livestock that can be used as food in times of adversity and in extending and strengthening an individual's network of friends but this is an expensive way of providing such services. If such animals could be disposed of for money, which has few maintenance costs and is not at risk of destruction by disease, death, accident or theft (if kept in a bank), the same purpose could be served

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[4] Local inspected slaughter more or less represents slaughter of animals in local butcheries. This is because pastoralists rarely call meat inspectors to inspect meat for domestic consumption. It is however a crime to sell uninspected meat.

without wasting the society's grazing and resources (Hopcraft, 1980).

Livingstone has argued that when one looks at livestock to man ratios in pastoral societies, most of them do not have enough animals to guarantee subsistence, let alone provide a surplus for sale (Livingstone, 1982). These livestock to man ratios assume a closed economy where all food requirements must be met from livestock products. While this may have been true in the past it is no longer the case now and pastoral families can manage on much fewer animals if they sell a few and purchase supplementary foods or if they make use of opportunities to earn incomes from petty trade or paid employment. Even the person with a sub-optimal herd can still sell males that are surplus to his breeding and baggage camel requirements: infertile and culled animals which do not affect his herd's milk-yielding abilities or potential for increase in the number of productive animals. Indeed, it is the person without sufficient milk who is under pressure to supplement his diet with cereals and non-pastoral products that can be bought from the proceeds of such sales.

Most pastoralists seem to have realised this fact and are usually willing to sell such animals if the prices offered are good and there is a need for money. The demand for money is however limited by the lack of banks to save in, and lack of opportunities for productive money based investment (Njiru, 1983). Such an environment inhibits the development of a completely commercial approach to livestock production. However, constant demands for markets and auctions by pastoralists, traders, politicians and administrators from camel growing areas indicate that the opportunities available are not satisfactory[5].

As a result, it is difficult for pastoralists to raise the money required not only for raising their standard of living but also for improving the health and productivity of their animals. These treatment costs can be quite high and in Rendille territory, a pastoralist requires at least 60/- per annum to keep

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[5] There are constant complaints in parliament about lack of a marketing organization dealing with all livestock looked after by pastoralists, while most district annual reports also contain reference to lack of markets.

each camel free from common diseases (Njiru-unpublished thesis). Lack of funds has led to a situation where only traders and pastoralists with non-pastoral sources of income regularly purchase drugs, acaricides and other materials required to keep their herds free from disease (Rutagwenda, 1983). Such treatment yields higher returns than it costs and their potential benefits are lost.

On the other hand, maintainance of these animals under conditions where the range is already overstocked, as is the case in some pastoral areas, increases the pressure on grazing and accelarates the rate of range degradation.

Possibilities for Improving Camel Marketing

This researcher is of the opinion that improvement of market prospects for camels are dependent on:

a) the possibilities for expanding existing markets,

b) the development of alternative markets.

Potential for Expanding Existing Markets

The demand for camel meat and products in the densely populated areas of Kenya is very small or non existent because the peoples living there prefer the more traditional meat of cattle, goats, sheep, pigs, and chicken. Many have never considered eating camel meat or are biased against it because camels are relatively unknown animals and their meat is 'suspect." Indeed, many of these peoples' knowledge of camels is only from photographs and newspaper reports. Camel meat is therefore mainly eaten in camel keeping areas and even here, smallstock and cattle meat still predominates as shown in Tables 2 and 3 above. Camel people do not show any special preference for camel meat and casual observation among well-to-do pastoralists seems to indicate that as the level of income rises, there is a tendency to eat less camel meat and more cattle and smallstock meat. It, therefore, seems that the potential for expanding domestic consumption of camel meat is rather limited unless an expensive promotion campaign is mounted.

Development of Alternative Markets

Given the limitations for expanding existing markets for camels, it seems that only new alternative markets can lead to a substantial increase in the demand for camels. The following new opportunities for raising demand are suggested.

a) Increasing the demand for baggage and riding camels.
b) Exports of camels to the middle east and neighbouring countries.
c) Production of meat extract, bone meal, fat, dried meat, and other by-products from camel slaughter.

Increasing the Demand for Baggage and Riding Camels

Early government files indicate that camels were extensively used as a form of transport in the then Northern Frontier District. This facilitated movement in places where roads were not available. With the building of more roads and tracks and the availability of 4-wheel-drive vehicles the practice of using camels as a means of transport was slowly discontinued. In recent times, high petroleum costs have made coverage of the large distances involved in the sparsely peopled arid areas extremely expensive. Lack of foreign exchange to purchase vehicles and petroleum has also led to the presence of too many old vehicles which frequently break down, and the lack of petrol to make the necessary trips[6].

In any case, motorised transportation, even with good vehicles and fuel can only enable government officers to reach people who are reasonably near to a road. Where the ratio of kilometers of roads to area is as low as in Kenya's arid lands, a very large section of the community cannot be reached.[7] This is more so where the population is nomadic and is constantly moving so that a close network of roads is necessary. Opening up a basic network so that a large proportion of the population are near a road would require enormous funds which the government does not have. The maintainance of many existing roads is, in any case,

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[6] In 1982, for example, a Marsabit district vaccination campaign was stopped halfway due to lack of funds to buy fuel.

[7] In Marsabit there are only 0.02 kms. of classified roads per sq.km. of area. (Kenya Govt., 1980).

very poor. Most are dirt roads which are impassable during wet periods. This therefore means that even in the best of times the delivery of many essential government services is only possible to the small portion of the population who can be reached. With the current money problems the delivery of such service is even more restricted.

This researcher believes that the reintroduction of pack and riding camels into government service in all pastoral areas where this is possible can improve the delivery of government services for the following reasons:-

i) Camels are able to go to most habitable places on the range, as they are not dependent on roads or tracks.

ii) They have low maintainance costs since they can feed on available grazing. Where feed supplementation is required, this can easily be done with locally produced cereals or fodder crops.

iii) Government officers, on camel back, will be in closer contact with the problems pastoralists face and are more likely to give better advice.

iv) The capital costs are much lower than costs of the four-wheel-drive vehicles now provided. This is because a baggage camel costs only 2,000/- while a landrover costs over 150,000/-. It can give service for upto 10 years while a landrover breaks down after two to three years of use in the rough conditions of range areas.

The suitability of this mode of transportation has been demonstrated by UNESCO's Integrated Project in Arid Lands (IPAL) whose extension and research work has used camels with very satisfactory results. In the commercial ranches of Laikipia and the coast, some enterprising ranches have also found the use of camels for movement of herds within the ranch very useful (Evans and Pows, 1979).

If the government accepted this suggestion, some research work would be needed to determine how many camels would be required by each of the different cadre of staff who would use them.

Experiences gained in the use of camels for transport in East Africa and Asia has been well documented in various published and unpublished reports.

Adoption of such a policy would in any case create a very large demand for camels and provide a boost to camel producers.

Export of Camels

Government camel files stretching from 1923 indicate that the presence of a market for camels in the middle east has long been recognised by top policy makers. The actions taken include:

a) A trial shipment of five camels in cooperation with a local company which was interested in conducting such trade in October, 1966.
b) The sending of a fact-finding mission comprising of veterinary and livestock marketing officers to Jeddah in June 1969.
c) A number of proposals for camel projects to increase camel production and to facilitate export of the camels by the government or by private traders.

Despite all these efforts, very little direct exportation of Kenyan camels to the Middle East has taken place though illegal export through neighbouring countries mentioned above has been suspected.

It has, however, been established that a market for live camels does exist in Saudi Arabia. The 1969 mission found that imports through the port of Jeddah alone varied from 15,000 to 35,000 camels a year, depending on rainfall conditions in the camel growing areas of Saudi Arabia. When rains were poor, local animals did not grow fat necessitating a high level of imports. When rains were good, local animals were able to increase supplies to slaughter houses thus reducing the level of importation. The heaviest demand for imports was in the cold season, from November to April, and during Ramadhan. Importation of females was barred on religion grounds and big fat males fetched the best prices of

of about £70[8]. Most of the animals came from Somalia ports with Berbera providing almost all and Mogadishu and Kismayo small numbers. Jeddah importers were however unwilling to place firm orders for Kenyan camels until they had seen photographs or live ones. They were insistent that they could only guarantee at least £40-£50 per camel on an initial trial batch of 100-200 animals. If these weighed between 450 and 600 Kg., much higher prices would be achieved. The Kenya government estimated that it could land camels at Jeddah at a total cost of £ 43.7. This included all trekking and shipping charges, a 3% commission to the agent selling the animals at Jeddah and purchase at the going price of £ 20 in North Eastern Province. This costing was made after careful verification that these estimates were as close to actual costs as possible and is reproduced in Table 4 below. It showed that even at the

Table 4: Estimated Costs of Transporting 250 Camels to Jeddah - May 1970.

	£
Camels 250 @ £20	5,000
Shipping charges	4,000
Discharge @ 10/- per head	125
Loading: No charge caused by LMD staff at Lamu	-
Agency fee	120
Lamu Port fee	75
Selling Commission 3%	345
Insurance 6%	450
Trekking and Buying Costs	375
Feed at 35/- per head	437
Total	£10,927

Average cost of Jeddah £ 43.7

Source: Ministry of Agriculture Camel Files.

bottom price of approximately £ 45 which Jeddah importers were willing to guarantee without seeing the animals, the government could cover its costs and still manage £ 1.3 profit per animal.

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[8] Enquiries by livestock marketing officers revealed that at that time domestic camel prices were approximately £ 15 in Turkana, £20-£25 in Maralal and £ 15-20 in North Eastern Province.

An earlier trial sale of five camels by a commercial company in October 1966 had resulted in further orders of 60 camels which the company was willing to buy at 250/- per animal in Mombasa. The company did not give detailed information on prices realised and the costs of the operation. These camels were moved by truck to the coast at a very high cost of 200/- per animal because a truck which normally carries 16 head of cattle could only carry five camels. In its report to the government, the company indicated that such transportation costs would make export unprofitable and advised that in future, cheaper forms of transportation would have to be found.

Two methods were suggested. These were trekking camels to Nanyuki and sending them by rail to Mombasa, and walking the animals all the way to the coast. Though the first method was bound to be cheaper than using a truck it was still expected to be expensive. The last method was the cheapest if armed guards to protect the camels from raiders could be provided and a way of preventing the infection of the camels by trypanosomiasis as they passed through areas infested with biting flies could be found[9]. The trip to the coast would take two months and camels were not expected to loose any weight because they would graze on the way.

We have not been able to get any reports of whether any railing or trekking of camels has ever been done. The above company was not able to export camels on a large scale because of the start of shifta disturbances in the late 60s[10]. This led to a deterioration of security in the North Eastern Province and to the cancellation of initial orders due to too many delays.

Shift in Emphasis

In the 1970s aerial surveys revealed that Kenya's camel population was only about 600,000 head and not the 1.5 million previously estimated. Emphasis now shifted from trying to find an

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[9] Camels are very susceptible to trypanosomiasis, which leads to a deterioration of condition.

[10] These disturbances arose from Sessionist attempts by some north Kenyan tribes with some backing from the Somali Government.

export market for camels to trying to find ways of increasing the productivity of camels and thus ensuring that any exports would not lead to a decrease in the camel population. Such a decrease was expected to result from the development of a large export market unless present disease constraints to production were removed. This concern has continued to the present day and several project proposals to improve and study camel diseases have been made.

IPAL has done pioneering work on camel diseases as constraint to productivity (see Wilson et al. 1981, Rutagwenda 1982, and Field et al. 1983). These studies show that it is possible to control camel diseases in a cost effective manner and to increase camel growth rates quite substantially. It is therefore possible to export camels without reducing the pastoralists subsistence base.

These IPAL studies have also shown how Trypanosomiasis can be effectively controlled through the use of drugs. Camels can therefore be walked to the coast without any fear of significant losses. On the other hand, demand for live camels in the Middle East is still high and Somalia is still exporting a large number of camels to these markets (Somali/Swedish Mission, 1982). Table 5: below shows Somalia's Camel exports between 1970 and 1979. Most of these are to Saudi Arabia. According to the same source

Table 5: Somalia's Camel Exports 1970 - 1979

Year	Number
1970	25,808
1971	23,707
1972	21,196
1973	27,914
1974	23,692
1975	33,351
1976	36,622
1977	34,602
1978	20,968
1979	12,503

Source: Adapted from Somali/Swedish Mission p. 9

Somalia supplied over 50% of SaudiArabia's total meat import requirements in 1982. There seems to be a decrease in numbers supplied since the peak exports of 1976. If this is due to over exploitation of Somalia's camel population in the past as has been suggested by some traders familiar with Somalia, this means that Kenya's camels would go to a market already experiencing shortages.

Legalisation of Trade with Somalia

Since trade across the Somali border is known to exist, it would be in Kenya's interest to legalise it. This would ensure that Kenya gets foreign exchange from camel sales to the Middle East through Somalia. It may be that Somali's can offer a better price than what Kenya's exporters could offer. If this is the case it would be economically unwise to try and incur exportation costs if Somalia whose northern ports are very near the Middle East could do so more cheaply.

Of course, there are political considerations involved and international trade is rarely based on pure economics. Such considerations are however beyond the scope of this paper. Suffice to say that the scope for increasing Kenya's camel exports in the Middle East and to neighbouring Somalia needs further exploration.

Establishment of Abbatoir(s)

Export of camels can only cater for large and fat male animals. Females, culled baggage and riding camels and others not suitable for export would still remain. As stated earlier these already comprise a sizeable proportion of existing herds and their existence cannot be ignored. It is suggested that these animals be put into economic use through the establishment of one or more abbatoirs to convert them into dried meat, meat and bone meal, fat, liver [illegible] and any other by-product for domestic or export sales.

Such an abbatoir was in fact maintained at Archer's Post from 1950 to 1966, providing an outlet for such camels. It served the whole of North Eastern Province, Marsabit, Isiolo, and Samburu while another one, in the Rift Valley, served areas further west. These abbatoirs provided an outlet for weak animals and at the same time provided useful raw material for the animal

feeds industry, the soap making industry and a source of cheap proteins for the poorer sections of the population. Exports to Uganda and other countries were also effected (Archer's Port Abbatoir Annual Reports 1950 - 66).

Upto 1963, there were no problems of getting supplies of animals or being able to sell the abbatoir's products. Indeed, the abbatoirs had problems of receiving more animals than they were able to cope with[11]. Between 1963 and 1966 however, the abbatoirs started experiencing problems which led to their closure. The Archer's Post abbatoir was closed in 1966.

The reasons for closure are difficult to establish from annual reports. It seems that as time went on, traders started demanding higher prices than the abbatoirs were able to offer. At the same time the quality of their products declined, leading to a fall in orders as former customers looked for alternative supplies. More research is, however, needed to establish exactly what lead to the closure of these abbatoirs without the provision of alternative markets for animals they were helping provide an outlet for[12].

Since the closure of these abbatoirs, the livestock feeds industry and other industries which could make use of products from such an abbatoir have grown. The development of a preferential trade area in Eastern Africa has also opened markets in neighbouring countries. It is therefore proposed that the possibilities of re-establishing abbatoirs should receive serious consideration by the Government. The ideal situation would be for private companies to do so with government technical and financial support if the latter is found to be necessary. A proper feasibility study to ensure that such a proposal is viable is however mandatory.

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[11] There is a lot of correspondence on this matter in the files, as it appears that maintenance of too many animals on the abbatoirs grounds led to large losses from starvation.

[12] It has even been suggested that South Africa was an important market for the abbatoirs and the cessation of trade links with Apartheid regime at Independence was the main cause of the abbatoirs closure (Personal Communication from C.R. Field).

Conslusions and Recommendations

In this paper it has been shown that the market for camels in Kenya is presently very poor and that pastoralists have few opportunities for raising cash from the sale of camels. The prospects for improving the market for camels by creating demand through:

a) the re-introduction of camels as transport animals,
b) development of export markets and
c) the establishment of abbatoirs for processing camels into useful by-products, have been explored and found promising. The analysis however, used information that is rather dated.

It is therefore recommended that to facilitate better decision making, thorough studies into the following be undertaken.

a) A study to establish the suitability of the reintroduction of the camel as a transport animal in government service. This should look into the logistics of the exercise, how to cope with the management of such animals, and the establishment of guidelines on how the animals should be handled.

b) A study to establish the feasibility of exporting animals to the Middle East including:

i) A survey of Middle Eastern camel markets and the competitive position for Kenya's camels.

ii) A survey of the best method of transporting the animals to the coast. This should evaluate whether this should be done by trekking them there, by rail or through Somalia. Whichever method is selected, the survey should make proposals for the establishment of the necessary infrastructural supports.

iii) A survey to establish the potential sources of camels for supplying the demand for transporting animals, for export, and for the abbatoirs proposed.

c) In relation to abbatoir(s) proposal, the current demand for the end-products in Kenya and in export markets should be studied. The running of similar establishments elsewhere in Africa or the developing world should also be studied to avoid the many failures that have been experienced in livestock sector development projects in the past (ILCA, 1980).

Lastly, close attention should be paid to the economics of either establishing one large centrally placed abbatoir, or a few small ones, each catering for a small area and avoiding the covering of large distances by weak animals. These studies should then culminate in the designing of appropriate projects for implementation by government or private enterprise.

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RESEARCH PRIORITIES AND PROSPECTS

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This seminar was one of several planned for countries in Africa having substantial populations of camels and camel pastoralists. These seminars have been planned to address problems specific to camel pastoralism, but these problems are often similar to those facing all pastoralism in Africa, and awareness of the difficulties facing camel pastoralism and the nations in which camel pastoralists live, and perception of just what issues are involved, has been influenced by research and policy debates concerning pastoralism in general. Since most of that discussion and debate has been carried out with regard to cattle pastoralism, it was justifiably considered timely to convene a set of meetings which would synthesize existing knowledge on camel pastoralism, and stimulate deliberations more pertinent to the camel and conditions in the more arid lands.

At the more general level, the seminar reflected a more pervasive sense of crisis with regard to livestock production in Africa and its future directions. Paradoxically, livestock production is the only economic domain where "development" is often seen to require a certain "devolution" of the system of production, through sedentarization of pastoralists, decreased mobility of herds, destocking (or in more economic terms, deaccumulation of capital), and marketing at non-economic rates. At the same time, governments and pastoral development agents often emphasize the need for fundamental social change, including alteration of local community values, close interaction between human and animal populations, and economic and religious emphasis on livestock. "Development", then, has come to connote for the camel pastoralist not only a set of policy prescriptions and practical interventions which would result in economic devolution but also a process of social devolution which would undermine their essential camel culture.

This is not to say that current directions of much pastoral development do not represent reasoned responses to the perceived problem:

rangeland degradation, combined with low market involvement, two outgrowths of pastoralist strategies of livestock accumulation. To make the matter more complex, cycles of drought often decimate herds, which are perceived to have created the conditions of their own demise through overgrazing. Then, the responses of government agencies are limited to the requirements of survival of human populations threatened by famine. They must provide or facilitate provision of food relief and should encourage restocking. The cycle turns. Thus policy towards the rangelands inevitably involve two contradictory perceptions and responses: in response to perceived range degradation, herds should be decreased through active destocking, increased marketing, or indirect pressure through grazing land sub-division; but in response to drought and other constraints on production, such as shortage of water sources, animal disease, or labor shortages, herds should be increased. Another paradox is that policy is carried out in terms of the perceived poverty of herders, whose standard of living, health, and nutrition is seen to be inadequate, and yet many planned interventions result in lower productivity, greater income disparity between herders, and in some cases even lower levels of health and nutrition in settlements dependent on marketed food-stuffs than in nomadic homesteads which increase economic productivity and leave disease behind with each move. Similarly, market involvement should bring greater diversity of food and a means of counteracting the great variability in food supplies based on pastoral production, but dependence on the market can render pastoralists even more vulnerable to drought, famine and poverty if nation-wide distribution of goods is unreliable, especially during regional deprivation and higher demand for food-stuffs, or pastoralist incomes are inadequate to purchase whatever is in actuality available.

It is a positive sign that participants in the Seminar emphasized a forward looking concept of development in the rangelands, with focus on means of increasing livestock productivity, both for higher levels of marketing and for increased standards of living and subsistence for domestic units. In particular, the Seminar contributed a clear understanding of the value of the camel in the complex situation sketched above. Physiologically, the camel represents a remarkable adaptation to areas of high aridity and heat with widely dispersed vegetation and water sources. Their techniques of browsing and heavily padded feet make them much less damaging to the soil and vegetal environment than their bovine, caprine and ovine counterparts, and in addition, their browsing preferences make

them complementary to these other species. They are thus very well-suited to pastoralism practiced in the arid lands having very low human population densities and widely dispersed resources: camels make efficient use of resources and survive for many days without water, while having the capacity for rapid, long-distance movement, between distant water sources and pasture both for their own consumption or as human baggage carriers; camels also provide extremely high yields of milk, and in strictly economic terms, transform cellulose into human calories much more efficiently than do cattle. However, camels reproduce very slowly and require a significantly greater labor force to look after them, and in the more arid areas the exigencies of providing subsistence to families and pasture to camels often results in a household divided and dispersed throughout much of the year. Some Seminar contributions emphasized the internal and regional market potential for camel meat and milk and animals on-the-hoof for export, to be used for human consumption and transport. Others emphasized the economic returns to camel-keeping households and their salutary effect on the natural environment, pointing out that very little marketable surplus existed in herds used for local subsistence and transport.

Each paper represents a report on research in a particular social or scientific field pertinent to camel pastoralism, and many papers also sum up research already accomplished in the field and point out priorities for future research. Often, papers demonstrated the value of interchange between knowledge derived in a given field through direct observation or experimentation, and knowledge gained indirectly from pastoralists. This is true not only in the social scientific fields, where informants always play a crucial role in setting forth the cultural assumptions and values critical tothe functioning of social systems, but is equally true in the natural sciences, the scientific results of which are both enhanced - through use of indigenous experts - and validated through use of local systems of knowledge or "ethnoscience". Pastoralist knowledge about local botany, soil types, wildlife, ecological human/animal/environment interactions, domestic livestock diseases or markets represents an invaluable reservoir and inventory for the scientist trained more broadly in a given field but without the experience of years of observation and practical life in a given arid area. This knowledge is also critical in providing insight into the way pastoralists perceive, interact with and use their natural, animal and social environments, since any form of pastoralism represents a dynamic and creative

set of choices or selections out of the possibilities offered by the environment and its resources. We need hints and indications of what is of value, consequence or emphasis for the pastoral system, and these indicators are offered by the pastoralists themselves. Much of this knowledge, as well as the essential motivations which drive diligent and efficient forms of animal husbandry in dry and arduous lands, is supported by a more general camel culture, which provides the cognitive framework and intrinsic rewards for a rich, satisfactory and meaningful life for pastoralists. As policy discussions dwell on social and technical means of transforming or altering the pastoral system, we had best keep in mind the mutual reliance of indigenous systems of technical knowledge and practice and cultural systems of value, belief and meaning, for if the entire camel culture is weakened or its committments forgotten in the wake of planned change, not only the quality of life but also the essential know-how of pastoralists may be diminished.

Accordingly, the following issues have been extracted from the substance of Seminar presentations and discussion with two major points kept in mind: that each issue usually requires a dialectic between scientific observation and local knowledge, and that understanding camel pastoralism usually implies attention given both to the scientfic domain and to the operation of the social system by which it functions. In this brief discussion, we will identify the issues and research priorities relevant to it, and then pose an essential question of practical policy which the issue raises.

Animal sciences and husbandry:

More research is needed in areas of animal genetics, reproduction processes and animal nutrition, as well as the crucial area of camel diseases and veterinary practice. These areas of applied biology address some of the crucial limitations on animal production, and thus bear directly on successful and productive forms of husbandry practiced by camel pastoralists. Needed as well, is study of domestic animal behaviour, since pastoralist perceptions of behavior, combined with their perceptions of the biological needs of camels, act to determine their economic practices, such as species diversification, herd composition, movement patterns, and labor allocation.

Question: Can knowledge derived from applied research in the animal sciences be channeled to pastoralists through reliable, long-term

programs of extension, which will enhance productivity and local economic security? And can market processes and extension services ensure long-term access to veterinarian medicines and supplies, if pastoralists and their animals become dependent on their use?

Range ecology and resource allocation

Another critical limitation on animal production is the availability of essential range resources over seasonal and longer-term cycles of rainfall. Some important issues for future research concern the impact on vegetation of rainfall variability, the nutritional value of given volumes and qualities of vegetation, and nutritional competition/complementarity between domestic livestock and wild fauna, and between different species of domestic livestock. More should be known about pastoral systems of resource allocation and use, including techniques of herd movement between vegetal, mineral and water resources, institutions allocating rights in range resources of individuals, settlements and larger political bodies, and processes by which resources are conserved and allocated throughout the year. Another critical question is the extent to which current changes of land tenure will prohibit access to necessary resources by camel pastoralists, and to what extent stocking rates effect long-term pasture viability and how altered land tenure will effect herd sizes and stocking rates.

Question: Will government assure the security of pastoralists from armed incursions, so that range resources can be most efficiently used and systems of resource allocation judged on economic grounds? Will interventions in the rangeland tenure systems ensure both a positive effect on rangeland ecology and continued political and economic security for pastoralists?

Labor allocation and household economy

We should learn more about the technical labor requirements of camel pastoralism, and the average/optimal ratios between herd sizes and human populations, one factor of which is the labor necessary for a given herd vis-a-vis the population which can be supported by a given herd. The labor process of dividing households into spatially separated herding villages and camps should be better understood, as it bears on the best allocation of land and resources. Also important is better understanding of the balance between foods produced for subsistence by herds and marketed

foodstuffs, and the economic implications of this balance for households, as well as the nutritional outcome.

Question: Will processes of sedentarization and educational participation strengthen the pastoral system, or will they weaken the labor force, diminish household autonomy, and undermine committment to the camel culture, so important for increased rural dynamism? If pastoralists become more dependent on the market for food, will supplies -especially of grains - be ensured through seasonal cycles and cycles of drought, compensating for the security of herds?

Livestock marketing

Many rangeland developers emphasize the importance of increasing volumes of livestock marketed and the percentage of annual herd offtake. Yet we need to know more about the impact of increased marketing and offtake on animal husbandry practices, herd structure and reproduction, and household nutrition. The question of herder decision-making regarding marketing and the factors involved in herder perceptions of gains and losses in marketing involvement needs to be further pursued. At a more macro-level, we should know more about internal and external export markets, and the way price structures vary in more remote and arid areas, as well as the type of return to a pastoral region from markets.

Question: If pastoralists are interested in increased livestock marketing, can the government provide reliable access to markets, facilities for marketing, and adequate price incentives so that returns will justify sales?

These are some of the critical research priorities for those concerned with the prospects for camel pastoralism, each requiring some combination of external and indigenous perspective, and an understanding of how technical and social institutions and practices interact. The Seminar expressed a growing sentiment both that camel pastoralism in the arid lands had received too little research attention, and that the potential returns from camel production - at household, regional and national levels - could be improved. Yet, if development interventions in camel pastoralism are to benefit both pastoralists and a national economy, they should be carried out in light of existing knowledge of the

value and resilience of current social and economic practice within the camel culture, and with the aim of increasing local productivity, political security, and social well-being. The research priorities set forth here represent directions which have been recently pursued, in particular by the UNESCO IPAL research program, but which need continued and persistent attention. One critical aim of such research in natural and social scientific fields is to provide the basis of knowledge on which policy can be devised, as well as to engage researchers in the policy debates which will so influence the lives of camel pastoralists and the camel culture in the arid lands of Africa.

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